AERONET Update

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Outline

• 20 Years of AERONET
• Recent Publications
• AERONET Version 3
  – Cloud Screening and MPL Validation
  – Updated Corrections and Ancillary Data Sets
  – New Products and Retrievals
• AERONET DRAGONs
• Future AERONET Distribution and Instrumentation
• MPLNET Update
AERONET Aerosol Robotic Network - Twenty Years of Observations and Research

The AERONET program is a federation of ground-based remote sensing aerosol networks established by NASA and LOA-PHOTONS (CNRS) and has been expanded by collaborators from international agencies, institutes, universities, individual scientists and partners.

AERONET provides a long-term, continuous public database of aerosol optical, microphysical, and radiative properties for aerosol research and characterization, validation of satellite measurements, and synergism with other databases.

- >7000 citations
- >400 sites
- Over 80 countries
Recent Publications


AERONET Version 3 Update – Cloud Screening

- Reevaluation of triplet and smoothness criteria (e.g., 0.02 and D16)
  - MPL-based Studies: Chew et al. [2011] and Huang et al. [2011]
- Emphasis on optically thin cirrus clouds as well as preserving observations of fine mode plumes and desert dust
- Comparison of test algorithms to AERONET Level 2 statistics (AOD, AE, and N) as well as MPLNET validation data set

Analyzed numerous cloud screening algorithm combinations and pared down to a few remaining components
  - Fixed Triplet or Variable Triplet
  - Aureole Radiance Curvature
AERONET Version 3 Update – Cloud Screening

Aqua MODIS
12 July 2011 6:55 UTC

Terra MODIS
13 July 2011 3:00 UTC

0.01 & No Curvature
0.01 & Curvature
Variable Threshold & Curvature

Observation at Singapore
N 01°17'51", E 103°46'48", Alt 30 m,
Since 12/07/2011
Until 13/07/2011
Device 050
11 points displayed
Level 2.0 - Quality Assured Data

Observation at Singapore
N 01°17'51", E 103°46'48", Alt 30 m,
Since 12/07/2011
Until 13/07/2011
Device 050
21 points displayed
Level 2.0 - Quality Assured Data

Observation at Singapore
N 01°17'51", E 103°46'48", Alt 30 m,
Since 12/07/2011
Until 13/07/2011
Device 050
15 points displayed
Level 2.0 - Quality Assured Data
AERONET – MPL Validation Data Set

- MPLNET cirrus only detection within 20 minutes of AERONET measurement
- AERONET measurement within various solar zenith angles (e.g., 30°)
- Homogeneous cirrus conditions assumed

MPL Validation Data Set (Cirrus Only)
MCC and %AERONET False Clear
Singapore - SZA < 30° - COD>0.06

Cirrus may not be homogeneous or in FOV of AERONET instrument

Singapore

AERONET False Cloud 275, 21.0%
AERONET False Clear 60, 4.60%

SZA<30°
COD>0.06
AERONET Version 3 Update – Additional Enhancements

• Temperature Characterization
• Level 1.5V NRT to provide real-time quality assured data set but will not have final calibration
• Update NO2 and O3 climatology (e.g., OMI)
• Update to new reanalysis data set (e.g., GMAO MERRA)
AERONET Version 3 Update
Sky Retrievals

• Possible Principal Plane Retrievals
• Lidar and Depolarization Ratios
• Implementation of a vector radiative transfer code
  – radiation field in UV (e.g., 380 nm retrieval)
  – degree of linear depolarization
• Uncertainty estimates for each retrieval (e.g.,
  random error plus biases due uncertainty in AOD and
  sky radiance calibration)
AERONET DRAGONs
Distributed Regional Aerosol Gridded Observation Networks

- Past DRAGONs
  - 2011 Maryland (Urban)
  - 2012 South Korea (Urban/Asia Outflow)
  - 2012 Japan (Urban/Asia Outflow)
  - 2012 Singapore (Urban)
  - 2012 Penang, Malaysia (Urban)
  - 2013 San Joaquin Valley, California (Urban)

- Current DRAGONs
  - 2013 Germany (Industrial)
  - 2013 Houston (Urban/Industrial)

- Upcoming DRAGONs
  - Colorado?
  - ?
AERONET DRAGONs

- Spatially distributed sun photometers deployed around aerosol sources (e.g., cities and industrial regions) over surfaces challenging for satellite remote sensing
- Provide 1 to several months of data in mesoscale distribution at high temporal sampling
- Complements air quality campaigns such as DISCOVER-AQ

Schafer et al., 2013 in preparation
• Current holes in the net:
  – Most of Africa
  – Northern and Central Asia
  – Northern South America
  – Northeastern and Western Australia

• Plan: Fill in the gaps;
  Need increase in funding, staff, and facilities

Expected 2013
AERONET

New Instrumentation/Enhancements

• Greater control over instrument measurement scenarios (e.g., Hybrid)
• Additional capabilities such as SD card storage, GPS, USB, and Zigbee
• Development toward attachment for CO2 measurements
• Synergism with MPLNET, PANDORA, and in situ measurements
Maritime Aerosol Network as a Component of AERONET

MAN represents an important strategic sampling initiative and ship-borne data acquisition complements island-based AERONET measurements.
SolRad-Net + Contributors as of May 2013

Circle - AERONET
Triangle - BSRN
Square - Other

Blue - Active
Red - Former/Temporary

New Long-term Sites
Bozeman
Appalachian State
Yonsei University
Toravere (BSRN)
AERONET Data Synergy Tool

http://aeronet.gsfc.nasa.gov/cgi-bin/bamgomas_interactive

• Utilized for data discovery, data download, and analysis
• New Product: HYSPLIT back trajectories
Micro-Pulse Lidar Network (MPLNET)

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Site Operations & Science Investigations
.... many network partners around the world

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MPLNET information and results shown here are the result of efforts by all of our network partners!
The Micro Pulse Lidar Network (MPLNET): Status of Network

Major focus on SE Asia the past few years. Aircraft have fled the region, but ground pounders still there. New focus for coming years: Southern Hemisphere (S America and Africa)

MPLNET Sites: 2000 - current

* most sites co-located with AERONET
Now that the summer 2012 intensive campaign is over, we are working to add more permanent stations in SE Asia. In addition to existing permanent sites in Taiwan, Singapore, and Hanoi, we are planning to transform Sumatra and Kalimantan, Borneo 2012 sites to permanent MPLNET/AERONET sites.
MPLNET extinction profiles are being used to determine the impact of CALIPSO aerosol typing on the satellite derived extinction retrievals. Boundary layer CALIPSO extinction tends to bias high over ocean due to assignment of “polluted dust” type.
AERONET Observations and Cloud Contamination: Detection of thin cirrus bias using MPLNET


Huang et al. Results:

- Two recent studies of observations from South East Asia demonstrate the difficulty in screening thin clouds during passive aerosol observations.
  - with cirrus present
  - without cirrus

- When cirrus were present, AOT results were biased high and the retrieved aerosol size distributions show a corresponding increase in large particles.

- A new improved AERONET data release is being developed. MPLNET cloud heights are used to verify the performance of the new cloud screening procedures.
A new MPLNET boundary layer depth algorithm has been developed, vast improvement over the current product.


**Figure 1:** (top) Example of MPLNET signals from GSFC July 1-2, 2011. New PBL product shown as red line, circles indicate PBL height retrievals from HU-Beltsville radiosonde. (bottom) All comparisons between MPLNET and HU-Beltsville PBL heights.

**Figure 2:** Comparison of seasonal diurnal cycles of the PBL height at GSFC for 2001-2008 using the new MPLNET algorithm (red) and GEOS-5 model (black). Orange vertical lines indicate the mean times for sunrise (SR) and sunset (SS).
Depolarization MPL Approved for use in MPLNET

Original depol MPL developed at ARM/Sigma Space years ago. However it had slow switching between co and cross polarization and the system characterization, calibration, and accuracy studies were never completed.

New depol MPL product developed thru interaction with GSFC/Sigma includes fast switching. Full system characterization and calibration study at GSFC is almost complete.
MPLNET Instrumentation: New Depolarization MPL

New depol MPL accuracy: ~ 1%. Discriminate aerosol features < 5% volume depol ratio

Molecular vol depol ratio for MPL is ~ 0.7% (light blue color below)
Adding Depolarization Lidars to MPLNET

Development has started on our Version 3 Data release (with new website)

• Several new products: new PBL height, depolarization
• Improved high cloud/cirrus retrievals
• Enhanced, better performing continuous day/night aerosol retrievals
• More efficient data file search, request, delivery
• More online tools for data visualization

Working to develop an automated QC/QA tool for MPLNET verification of aerosol models (GEOS-5, NAAPS, etc).