

# Cimel Sunphotometers: Highlights from Recent Deployments and New Data Product Developments

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## Cimel Sunphotometer Capabilities and Collaborations

### CSPHOT Introduction

The Cimel Sunphotometer (CSPHOT) is a multi-channel, automatic sun-and-sky scanning radiometer that has been deployed at ARM sites starting in 1998 at the SGP site. It is now deployed at all ARM sites.

### Capabilities and Uses

Each ARM deployment of this instrument is also part of the NASA AERONET (Aerosol Robotic Network) network which provides stable and well characterized calibrations (Holben). ARM data users often rely on this calibration for instrument intercomparison, satellite retrieval validation, as well as aerosol research, for which the network was intended.

### Collaborations and Data Products

Over the years, with close collaboration with AERONET, Cimel and ASR Scientists, the usage and capabilities of the instrument have grown. Data products for the Cimel Sunphotometer, developed by ARM and ASR scientists, are now used operationally by AERONET. Building on these collaborations, new products and capabilities are now in development



L. Gregory: CSPHOT on top of Bldg. 490 at BNL doing a direct Sun observation during the 2011 Aerosol Life Cycle Field Campaign.



AERONET: All AERONET sites



M. Roberts: CSPHOT at SGP in 2003



L. Gregory: CSPHOT at SGP in 2015

## Current Deployments and Data Products

Between 2010 and 2016, new scientific research combined with new instrument capabilities, enabled new data product development, widely available to the scientific community.

### Recent and Current Highlights

#### • New Deployments:

The suite of ARM CSPHOT instruments grew and the instrument became baseline for all AMFs and used for a variety of field campaigns. Recent and upcoming deployments include GOAMAZON (Brazil), BAECC (Finland), AWARE (Antarctica), MICRE (Macquarie Island), LASIC (Ascension Island) and DACCWA (South Africa)

#### • Cloud mode

Cloud mode was added to the instrument enabling zenith radiance measurements and, with further development, enabled ship deployments.

#### • Cloud Optical Depth (COD)

COD algorithms developed by Marshak and Chiu became operational at AERONET, used for data collection and processing world-wide.

#### • Antarctic Deployment

Most recently, the instruments were fitted to be deployed at the Antarctic sites at McMurdo and WAIS deployments



AERONET: Cloud Mode Sites where COD is available routinely

## Future Developments



### Future products and Features – to the Moon!

New features include improved COD algorithms and Lunar measurements:

#### • Improved Cloud Optical Depth Algorithm

Development is underway to develop an operational VAP for the 3-Channel Algorithms developed by Christine Chiu.

#### • SUN-SKY-LUNAR CE318-T

A new upgrade is now available by Cimel Electronic that includes capabilities to take AOT measurements at night (Barreto, 2016). The CE318-T is the recommended standard for AERONET. The new instrument is fully compatible with past versions and we plan to explore the possibilities for deployment in ARM.

#### • Automated Data Quality Checks

Currently exploring methods to look for signatures of failing instruments and automating data quality checks.

2016-2020

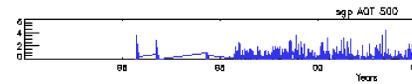
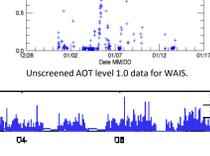
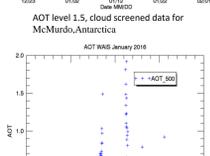
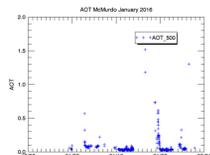
## Data Products: 1998-Today Aerosol Optical Depth and Derived Quantities Data

### Measurements

- Direct solar irradiance and sky radiance
- Direct Sun Measurements every 15 Minutes at 340, 380, 440, 500, 675, 870, 1020, and 1640 nm
- Almuqantar and Principal Planes up to 8 times per day

### Derived Quantities:

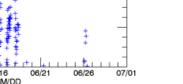
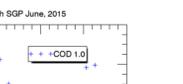
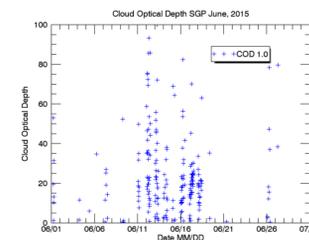
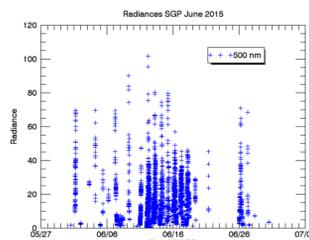
- Aerosol Optical depth (AOD) (Level 1.0, unscreened, 1.5 cloud screened, 2.0 cloud screened and Quality Assured)
- Size Distribution
- Phase Functions (coarse, fine)
- Cloud Optical Depth (provisional)
- PWV, Single Scattering Albedo, Refractive Index



1990's & 2000's

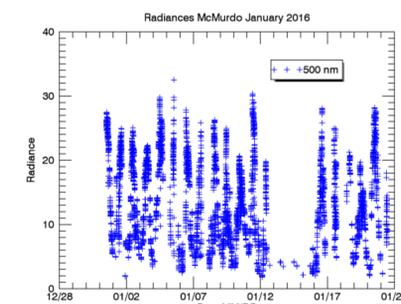
## Data Products for Cloud Optical Depth

- Cloud mode and cloud optical depth Retrievals were developed by ARM PI's C. Chiu and A. Marshak (Chiu, 2012)
- Tested and developed at ARM sites
- Now used operationally at many AERONET sites, making this the largest ground based network for cloud optical depth measurements
- Original retrievals relied on vegetated sites
- New retrieval (Chiu, 2012) developed to allow for COD measurements at non-vegetated sites, such as marine and snow covered environments.
- Currently we are working to ingest and archive the radiance and COD data products available at AERONET for instrument comparisons.

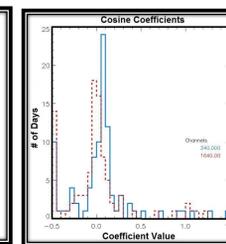
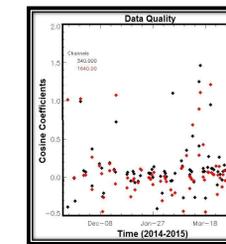
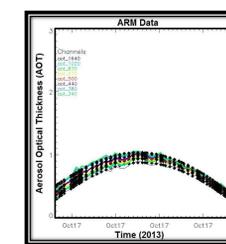


### New Products

Radiances, such as the sample data at right, will be used for the Cloud Optical Depth 3-channel Value Added Product.



### Automated Data Quality



Plots from preliminary work for detecting failures early. Left plot is an example cosine curve indicating obstruction in the tube. The right plots are data used for finding signatures for this type of error. This type of data is planned to be used to find features for machine learning algorithms to automatically detect failure. For example, the histogram shows an anomaly in the 340 channel. (Adams, 2015)

More Information:  
Cimel (CSPHOT) Instrument Page:  
<http://www.arm.gov/instruments/cspshot>  
Aeronet:  
<http://aeronet.gsfc.nasa.gov/>  
ARM eXternal Data Center (XDC):  
<http://www.xdc.arm.gov/>, [xdc\\_oper@arm.gov](mailto:xdc_oper@arm.gov)  
ARM Google:  
<http://google.arm.gov/search?q=Cimel+OR+CSPHOT+OR+CSPOT>

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