

Cimel Sunphotometers: Updates on New Deployments and Cloud-mode Zenith Radiance Data

Richard Wagener, Laurie Gregory, and Lynn Ma
Brookhaven National Laboratory, Upton, New York

2010 Enhancements

In 2010, the ARM Cimel Sunphotometer (CSPHOT) instrument status and data products were enhanced in several ways. As part of the deployment of the Boundary Layer Cloud System, six new units were acquired to allow for CSPHOT deployments at all ARM sites, with new additions at AMF2, Manus and Darwin, as well as replacement of older units, and an additional unit added to the calibration rotation. AERONET has begun to include the cloud optical depth retrieval from zenith radiance measurements operationally and provisional results are available from the AERONET archive. Some cloud optical depth data for ARM sites are available since 2004, because the algorithm was developed here.

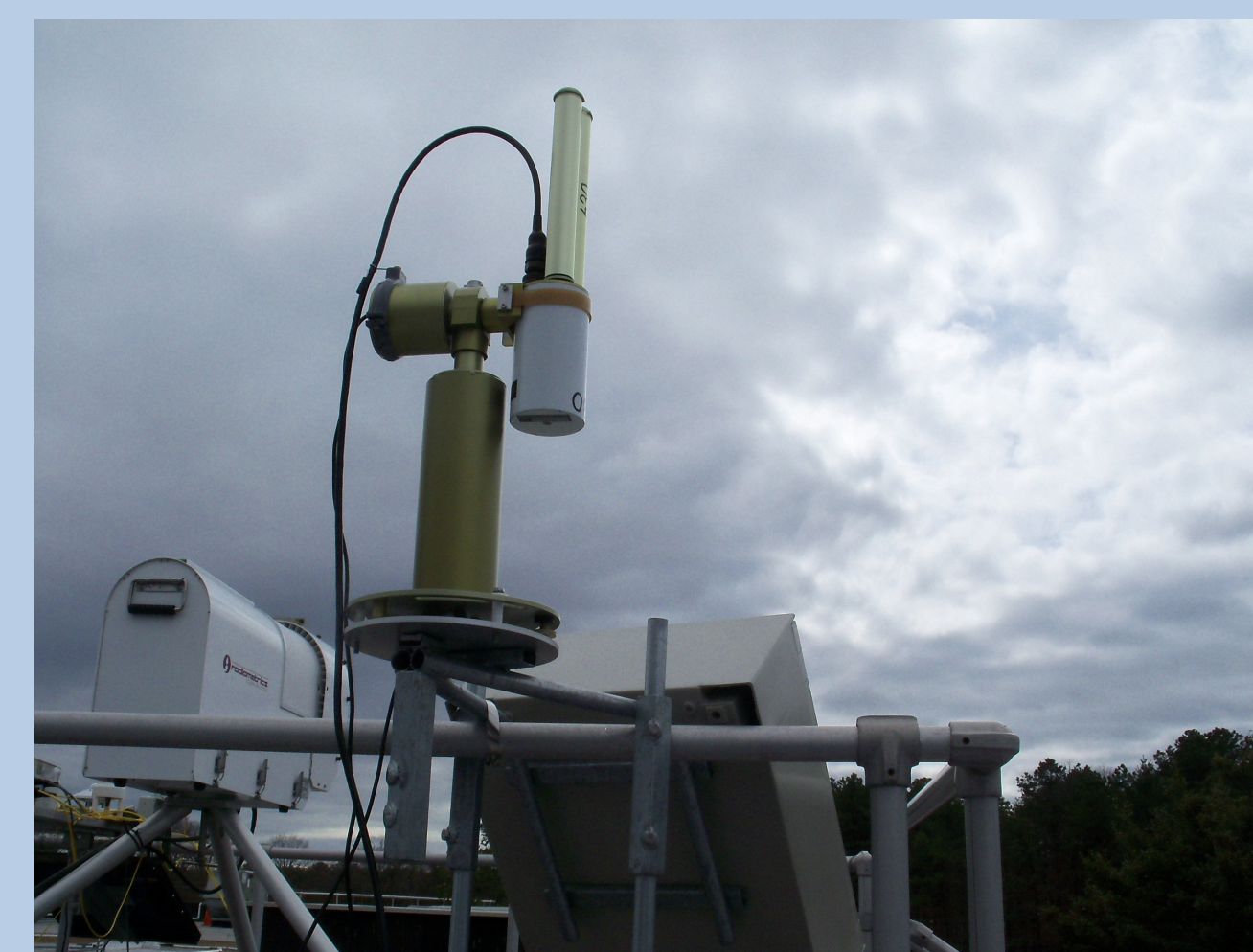


Richard Wagener(2010): AERONET outdoor calibration facility at NASA Goddard Space Flight Center during a visit on 2010-07-26. A few of the dozens of CSPHOTs that can be intercalibrated simultaneously.

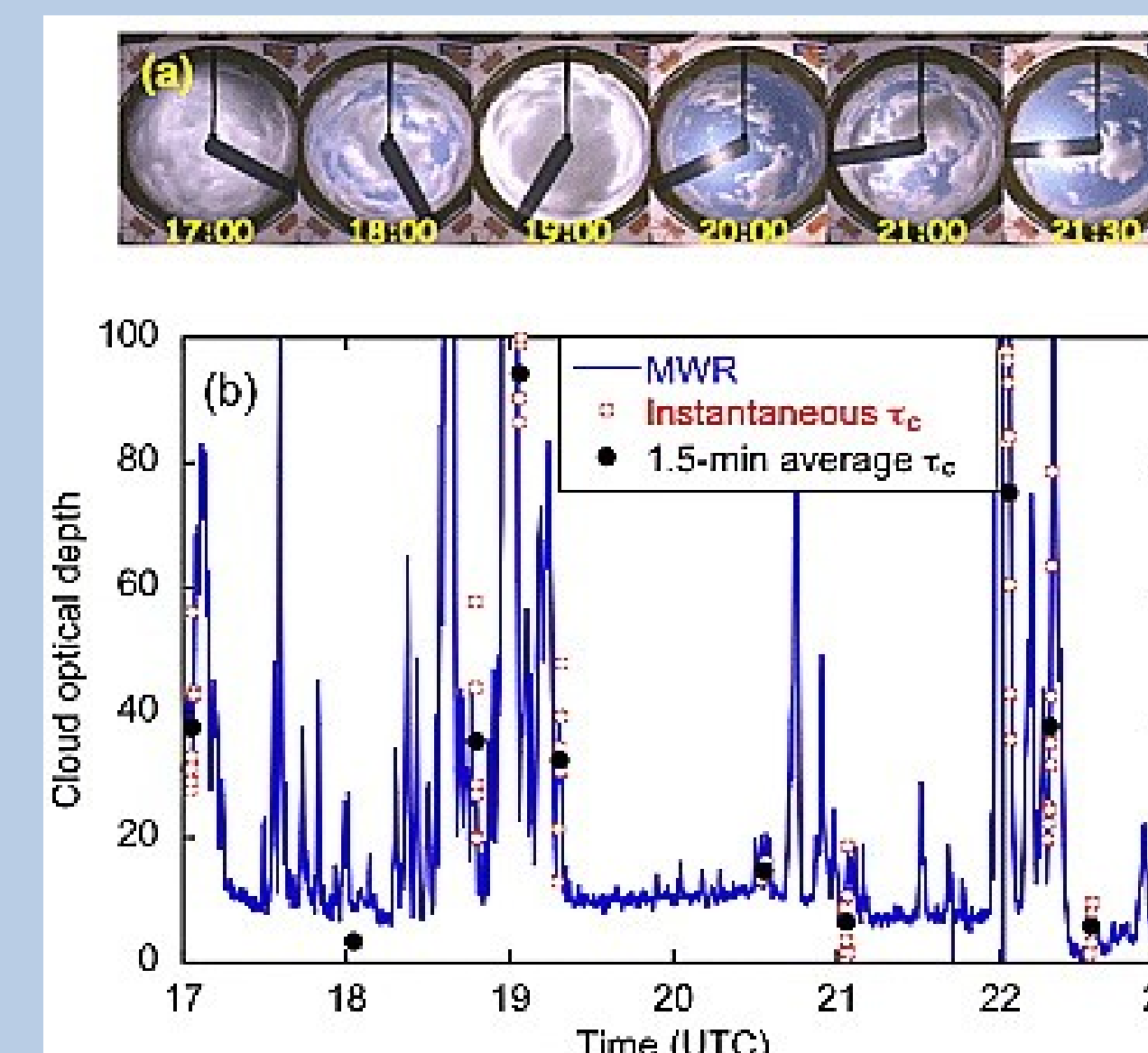
Cloud Optical Depth from Zenith Radiances

In the past, the CSPHOTs were only used under predominantly clear sky conditions to derive aerosol properties and the instrument remained in sleep mode during cloudy periods. Marshak et al. (2004) suggested that over vegetated surfaces cloud optical depth could be derived from ground-based zenith radiance measurements. Christine Chiu worked with AERONET using the CSPHOT at SGP to alter the observing strategy to include a number of zenith radiance observations during previously idle periods (Chiu et al., 2010).

- Operational at AERONET starting 2010
- Used in vegetated sites only (turned off during winter)
- Used in development mode at ARM SGP since 2004-11
- Of over 400 AERONET sites over 100 meet the cloud mode retrieval criteria and the archive currently contains cloud optical depth from 120 sites, which makes it the first large scale network for cloud optical depth.
- Beware of the limitations of the approach, i.e. Infrequent and non-continuous measurements, sampling biased towards overcast non-precipitating conditions.



Laurie Gregory (2011): CSPHOT on top of Bldg. 490 at BNL doing a zenith radiance measurement after a failed Sun acquisition.



From Figure 4 of Chiu et al. (2010): Comparison of CSPHOT derived Cloud Optical Depth with MWR measurements assuming an effective cloud drop radius of 8 μm . The Total Sky Imager views at the top are included to show the broken cloud conditions during this comparison at SGP on 2007-06-15.

Cimel Sunphotometer Measurements

Direct Sun and Sky Radiances

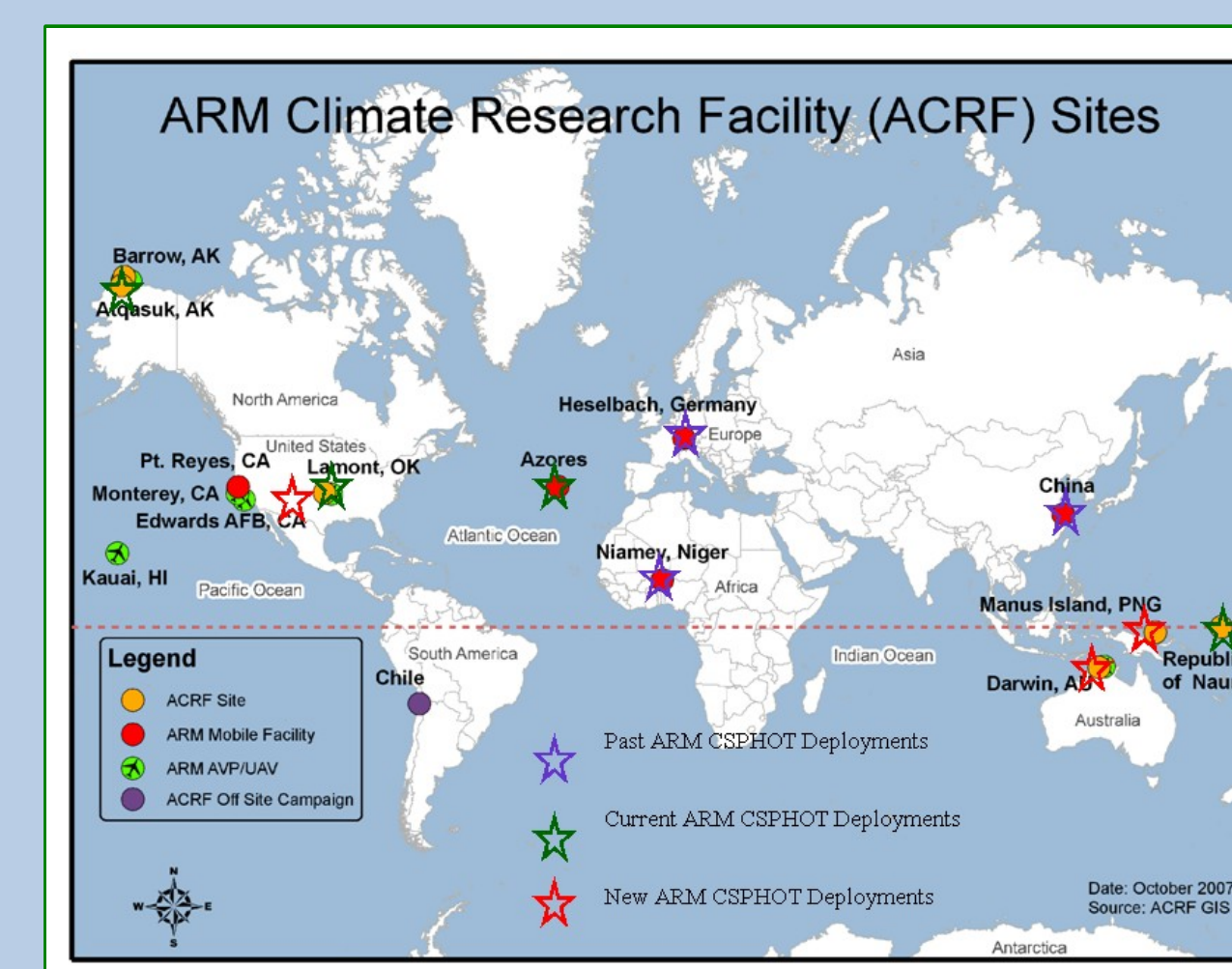
AOT Level 1.0	Unscreened Aerosol Optical Thickness (csphotaot)
AOT level 1.5 (Cloud Screened):	Cloud Screened Aerosol Optical Thickness (csphotaotfilt) (Not Q/A'ed)
AOT level 2 (Quality Assured):	Pre- and post-field calibration applied, automatically cloud cleared and manually inspected (csphotaotfiltqa)
Principle Plane	Calibrated Principal Plane radiance data (csphotpp)
Almucantar	Calibrated Almucantar radiance data (csphotalm)
Almucantar Retrievals	
Dubovik	Size distribution and optical properties derived by optimized retrieval from Sun and sky radiances (csphotalm1dubo)
Size distribution	Volume particle size distribution is retrieved in logarithmically equidistant bins from 0.5 μm to 15 μm . (csphotsize)
Phase function	Derived from almucantar sky radiance data (csphotpfn)

Cloud Mode Products (Available at AERONET)

Radiance	Zenith Radiance
COD Level 1	Cloud Optical Depth using the pre-field deployment calibration and surface albedo estimates
COD Level 1.5	Cloud Optical Depth using the surface albedo from the MODIS collection 5 products (MCD43B1)

New Instruments

Starting in March, 1998, ARM deployed Cimel Sunphotometers at several, but not all ARM Sites. As part of the Boundary Layer Cloud System, 6 new units were acquired. Previous site locations included SGP C1, NSA C1, TWP C2 (Nauru), TWP C3 (Darwin, previously owned by CSIRO), AMF M1 (Niamey, Black Forest, Taihu, Azores).



New site locations are:
TWP C1 (Manus), TWP C3 (Darwin), AMF2 (Initial Deployment at Steamboat Springs)

References:

- Chiu JC, CH Huang, A Marshak, I Slutsker, DM Giles, BN Holben, Y Knyazikhin, and WJ Wiscombe. 2010: Cloud optical depth retrievals from the Aerosol Robotic Network (AERONET). *Journal of Geophysical Research – Atmospheres*, **115**, doi:10.1029/2009JD013121.
- Marshak, A., Y. Knyazikhin, K. Evans, and W. Wiscombe, 2004: The "RED versus NIR" plane to retrieve broken-cloud optical depth from ground-based measurements. *J. Atmos. Sci.*, **61**, 1911-1925.

Brookhaven Deployment

One of the new Cimels has been deployed at BNL to be part of the Aerosol Life Cycle campaign of Summer 2011. It will provide column aerosol properties to supplement the very detailed in situ aerosol observations of the Mobile Aerosol Observing System (MAOS). An older CSPHOT will be retired from its ARM rotation to BNL after the campaign is completed. It will afford the IM the opportunity to better understand the instrument and help diagnose problems at the remote sites.



Laurie Gregory (2011): CSPHOT on top of Bldg. 490 at BNL doing a direct Sun observation.

More Information:

- Cimel (CSPHOT) Instrument Page:
<http://www.arm.gov/instruments/csphot>
Aeronet:
<http://aeronet.gsfc.nasa.gov/>
ARM eXternal Data Center (XDC):
<http://www.xdc.arm.gov/>, xdc_oper@arm.gov.
ARM Google:
<http://google.arm.gov/> search for "Cimel OR CSPHOT OR CSPOT"