What's new with ARM's automated Sun, Moon, and Sky radiometers (CSPHOT)

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

Recent and Upcoming Deployments

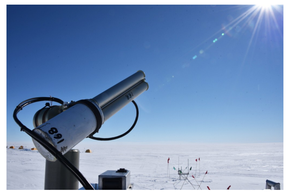
AWR(2015/2016): AWARE McMurdo and WAIS
- Fitted with 10m sensor head cables so control box could be kept inside warm trailer.
- Sent spare robots to cover for potential failures due to cold.

ASI(Ongoing): LASIC Ascension Island
- Near equator causes some zenith radiance observations to be saturated.

MCQ(Ongoing): MICRE Macquarie Island
- Raw data collected, but not yet delivered to AERONET for processing

DACCIWA(Summer 2016): Off-site European campaign in Benin and Ghana
- Collaborators: Christine Chiu (U. Reading), Barbara Brooks (U. Leeds), Norbert Kalthoff (Karlsruhe I.T.)

MARCUS(Fall 2017): Australian Antarctic Supply Ship
- Prepared unit 98 with continuous cloud-mode EPROM.



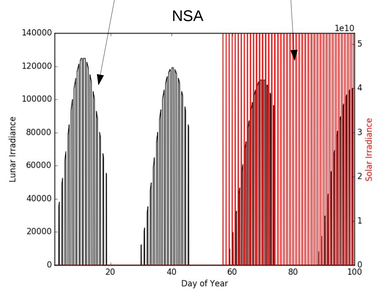
WAIS, purest sky on 1.8 km of ice

G. Stone McMurdo,Antarctica

Save, Benin

K. Nitschke Macquari Island

Coming Attraction: Night-time AOD



SUN-SKY-LUNAR CE318-T

ARM purchased 4 instruments of this new "Triple Mode" model:
- Direct Sun (AOD and PWV)
- Direct Night-time Moon (AOD and PWV)
- Day-time Sky Radiances (COD, Aerosol phase function and sizes)

Key improvements that also improve the precision of the daytime data:
- ☽ Better tracking and finer motor control.
- ☽ On board flash memory and SD card storage to minimize data loss in case of extended PC communication interruption.
- ☽ 32 bit, instead of 16 bit, eliminating need for digital gain adjustments.
- ☽ Reduced power consumption allows night-time observations using just solar power captured during the day and stored in the external batteries.
- ☽ Control box includes GPS receiver for onboard time synch. and automatic localization.

Deployment considerations and plans

- ☽ Greatest benefit expected for deployments in the arctic (NSA and OLI) to fill in the gap from October through April.
- ☽ Initially plan to deploy one next to the existing CSPHOT at SGP for intercomparison and performance evaluation.

Performance analysis

Barreto et al. (2016) have done extensive evaluation of uncertainty of the new CE318-T model and have found that night-time uncertainties are comparable to day-time uncertainty, at least for Lunar phases greater than 50%.

AERONET Version 3 Retrievals

- V3 Level 1.0: Unscreened data (<30 min delay)
  - New temperature corrections
  - Use NO2 from OMI L3 climatology
- V3 Level 1.5: New automated QC
  - Cloud Screening
    - Improves detection of optically thin cirrus
    - keeps more high and variable AOD (e.g. smoke)
    - comparable to V2 level 2.0
  - QC
    - remove temperature sensor artifacts
    - remove data affected by obstructions
    - remove data with poor spectral dependence
- V3 Level 2.0: based on level 1.5 with interpolated calibration between pre- and post-deployment
  - Minimal manual intervention improves timeliness
  - more objective removal scheme

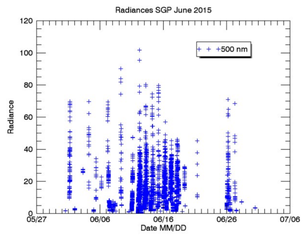
See: David Giles et al.
http://aeronet.gsfc.nasa.gov/new_web/Documents/AERONET_V3_AOD.pdf

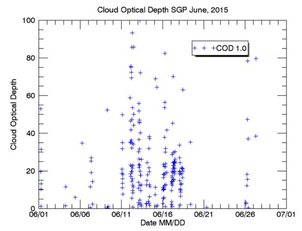
Cloud Optical Depth Retrievals

- ☁ 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 3-channel retrieval (Chiu, 2012) developed to allow for COD measurements at non-vegetated sites, such as marine and snow covered environments.
- ☁ Working to make both retrievals available as ARM data-products.

ARM. MAGIC Continuous Cloud Mode

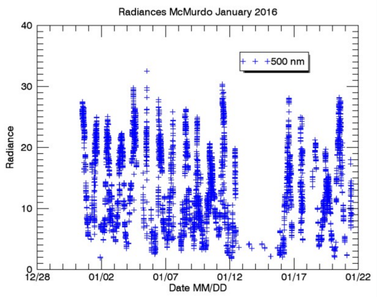
G. Stone McMurdo,Antarctica





New Data Products

- ●Zenith radiance: calibrated zenith radiance in 6 channels provided by AERONET: csphotzencldrad.a1
  - Ingest 90% done
- ●Cloud Optical Depth: two different cloud optical depth retrievals:
  - csphotcod1chiu (2-channel COD retrievals provided by AERONET)
    - 90% finished
  - csphotcod2chiu (3-channel COD retrievals run at XDC using the zenith radiances as input)
    - work in progress 75% done
- ●Update basic CSPHOT datastreams to use the new AERONET version 3 data.
  - not started, but should be straightforward
- ●Update level 2.0 retrievals



Automated Data Quality

See Poster "Laurie Gregory et al.: Anomaly Detection for ARM Radiometers using Machine Learning Algorithms"

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"

References:

Adams,, Brooke L. Gregory, R. Wagener, Automatically detecting typical failure signatures in Cimel Sun-photometer data to improve data quality, Poster presented at New York Scientific Data Summit, NYU ,New York, August 2-5, 2015

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Chiu, J. C., A. Marshak, C-H. Huang, T. Várnai, Robin J. Hogan, D. M. Giles, B. N. Holben, Ewan J. O'Connor, Y. Knyazikhin, and W. J. Wiscombe. ", Cloud droplet size and liquid water path retrievals from zenith radiance measurements: examples from the Atmospheric Radiation Measurement Program and the Aerosol Robotic Network." *Atmospheric Chemistry & Physics Discussions* 12, No. 8 (2012).

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