Section 4 Sunphotometer data processing: 4

General summary: In this section we explain how we convert raw AERONET aerosol optical depth data into hourly 550nm hourly column AOD. Locations of relevant AERONET sites are also listed.

Presently our single source of AOD files is AERONET (NASA) (Holben et al., 1998):

Table 1: Site names for all active (or soon-to-be-active) SPARTAN sites

Site Name	SPARTAN Site Code	AERONET site name and link*	Lat/long. AERONET	Lat/long. SPARTAN	Distance apart
Bandung, Indonesia	IDBD	Bandung	-6.888, 107.610	-6.888, 107.610	~ 5 m
Buenos Aires, Argentina	ARCB	CEILAP-BA	-34.5555 -58.5063	-34.5556, -58.5062	~ 20 m
Dhaka University, Bangladesh	BDDU	Dhaka_University	23.728, 90.398	23.7284, 90.3984	~20 m
Emory University, Atlanta, USA	USEM	Georgia_Tech	33.780, -84.3995	33.6880, -84.2905	14.4 km
IIT Kanpur, India	INKA	Kanpur	26.519, 80.233	26.519, 80.2325	~ 5 m
Mammoth Cave	USMC	IMPROVE-MammothCave	37.1319, -86.148	37.1319, -86.1478	10 m
Manila Observatory, Philippines	PHMO	Manila_Observatory	14.635, 121.078	14.635, 121.077	~ 5 m
Nes Ziona, Israel	ILNZ	Nez_Ziona	31.923, 34.7892 (being moved?)	31.9073, 34.8104	2.6 km
Tsinghua University, Beijing, China	CHTS	Beijing	39.9769, 116.381	40.0103, 116.3328	5.5 km
University of Ilorin, Nigeria	NGIL	Ilorin	8.4820, 4.6744	8.4842, 4.6746	200 m
Pretoria, South Africa	ZAPR	Pretoria_CSIR-DPSS	-25.7566, 28.2797	-25.7568, 28.2795	~ 5 m
Vietnam Academy of sciences, Hanoi	VNHN	NGHIA_DO	21.0478, 105.7996	21.0478, 105.7996	~ 5 m

Full link to **Site Info:** *http://aeronet.gsfc.nasa.gov/new_web/photo_db/[site name].html
Uncertain values are highlighted

Download level 1.5 or if available, download level 2.0 AERONET data. Download ANNUAL SDA Level 1.5 (or 2.0) spectra decomposition algorithm (SDA) data.

Level	AERONET Quality-Assured?	Description	Used in SPARTAN ?
1.0	**No**	**Unscreened and may not have final calibration applied**	**No**
1.5	**No**	**Automatically cloud cleared but may not have final calibration applied.**	**Yes**
2.0	**Yes**	**Pre and post field calibrated, automatically cloud cleared and manually inspected.**	**Yes**

Level 1.5 and 2.0 data are saved in the following format:
http://aeronet.gsfc.nasa.gov/new_web/data_description_AOD_V2.html

AOD input

Data	Date/Time	AOD (1020, 870, 675 500, 440, 380, 340)	Water column	AOD 3σ variance	440-675 angstrom	Solar zenith angle
Units	(dd-mm-yy, hh:mm:ss)	nm	cm	nm	none	Degrees

AOT output: AOD_550 (hourly), angstrom exponent, AOD_550 (fine), AOD_550 (coarse),

SDA file relevant contents

Row(s)	1-2	4-10	11	12-18	21	25
Contents	Date/Time	AOT (1020, 870, 675 500, 440, 380, 340)	Water column	AOT 3σ variance	440-675 angstrom	Solar zenith angle
Units	(dd-mm-yy, hh:mm:ss)	nm	cm	nm	none	Degrees

Export AERONET-downloaded files to

[Stetson]: gsnider/SPARTAN/neph_condensing_files/[Site name_code]/AOD/

For example, the level 1.5 2015 AOD data from Vietnam Academy is called

150101_151231_NGHIA_DO.ONEILL_15.csv

Matlab program for digesting AOD files:

[Stetson]: gsnider/SPARTAN/neph_condensing_files/AERONET_scan.m

What AERONET_scan.m does:

Matlab file "AERONET_scan.m" will read annual collections of AOD data and convert into hourly-mean values. Raw AOD data is spaced by several minutes per log or hours, depending on cloud coverage, but averaged into hourly blocks in order to align with hourly $PM_{2.5}$ data (c.f. **step 6).**

All the recorded AERONET times are in UTC, but we wish to convert to local time, hence all sites are changed via a time zone shift at start of file. As of now all SPARTAN sites are in Daylight Saving-free countries (save for temporary USMC and USEM sites), so no adjustment is needed during summer.

Output files "AERONET_scan.m" data are in the format

AOD_YYYYMMDD_YYYYMMDD_[Site_name/code]_hourly.csv
AOD_YYYYMMDD_YYYYMMDD_[Site_name/code]_daily.csv
AOD_YYYYMMDD_YYYYMMDD_[Site_name/code]_sat.csv

The "sat" data is daily, and averages only the AOD values between 10:00 and 14:00. It is the hourly file that is combined with the b_{sp} hourly nephelometer data (**section 5**) and 9-day $PM_{2.5}$ data (**section 3**) to form $PM_{2.5}$.

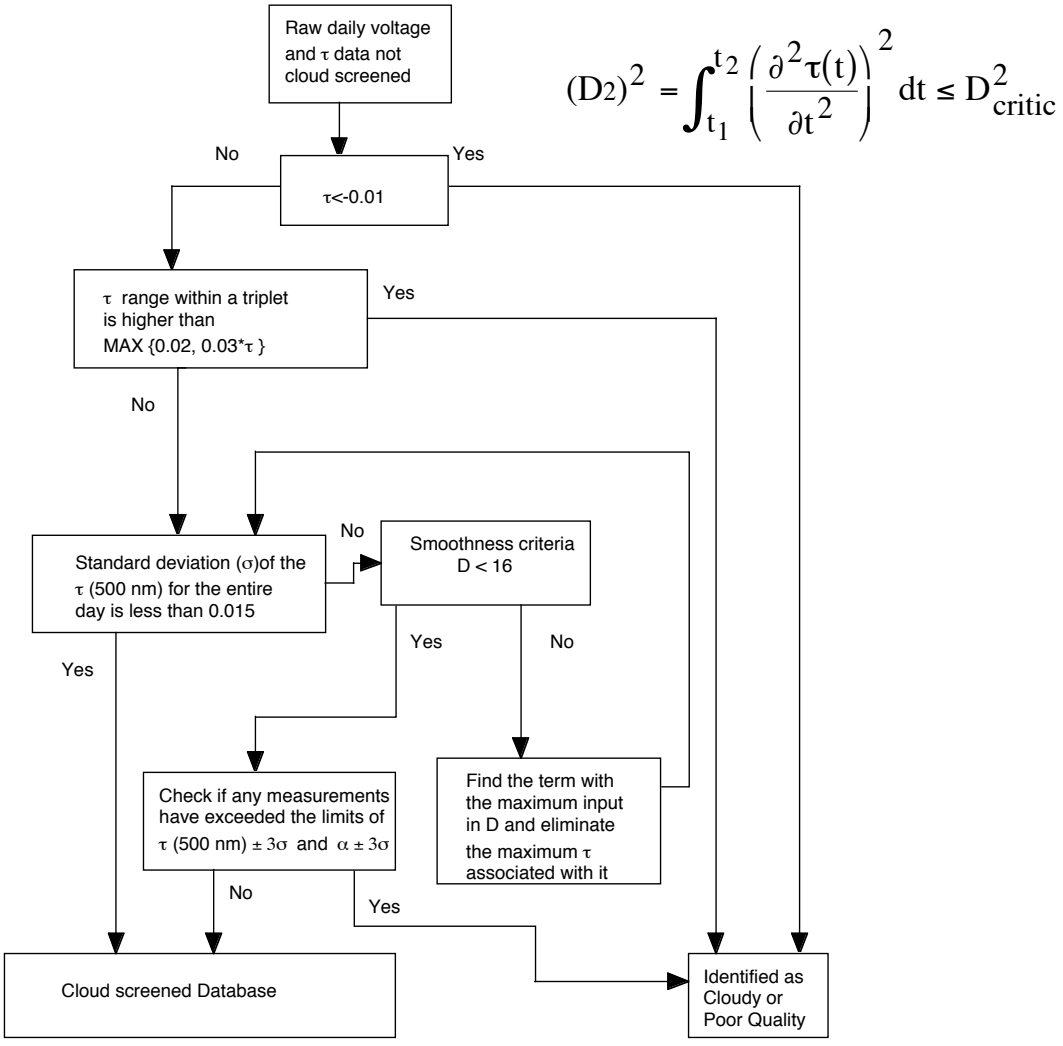

Figure 1: Cloud screening algorithm used by AERONET (Smirnov et al., 2000). The aerosol optical depth (AOD) as a function of time is $\tau(t)$, and D_{critic} is corresponds to the maximum acceptable variability of aerosol optical depth, i.e. $D_{\text{critic}} = 16$.

REFERENCES

Holben, B. N., Eck, T. F., Slutsker, I., Tanré, D., Buis, J. P., Setzer, A., Vermote, E., Reagan, J. A., Kaufman, Y. J., Nakajima, T., Lavenu, F., Jankowiak, I. and Smirnov, A.: AERONET—A Federated Instrument Network and Data Archive for Aerosol Characterization, Remote Sens. Environ., 66(1), 1–16, doi:http://dx.doi.org/10.1016/S0034-4257(98)00031-5, 1998.

Smirnov, A., Holben, B. N., Eck, T. F., Dubovik, O. and Slutsker, I.: Cloud-Screening and Quality Control Algorithms for the AERONET Database, Remote Sens. Environ., 73(3), 337–349, doi:10.1016/S0034-4257(00)00109-7, 2000.