The Micro Pulse Lidar Network (MPLNET)

Principal Investigator:
Judd Welton, NASA GSFC Code 612

Network Manager & Engineer:
Sebastian Stewart, SSAI GSFC Code 612

Data Processing:
Data Manager: Vacant
Larry Belcher, SSAI GSFC Code 612

Science Team:
James Campbell, Naval Research Lab
Jasper Lewis, UMBC GSFC Code 612
Simone Lolli, CNR, Italy

Administrative Support:
Lisa Nalborczyk, SSAI GSFC Code 612

CALIPSO Validation Activities:
Judd Welton, James Campbell

AERONET & Synergy Tool Partnership:
Brent Holben, NASA GSFC Code 618
Dave Giles, NASA GSFC Code 618

NASA SMARTLABS Field Deployments:
Si-Chee Tsay, NASA GSFC Code 613

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

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Windpoort, Namibia (borders Etosha Nat Park)
Photo: Seb Stewart

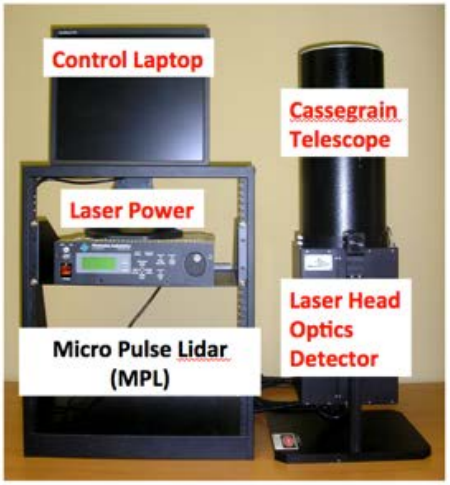
Summary of MPLNET: 2000 - current

- Objective: Long term, global lidar network to profile aerosol and cloud vertical distribution and properties at key AERONET sites

- MPLNET is a federated network built on the AERONET model: utilize standard instruments, calibrations, operations, and processing. Open data access via website.

- MPLNET History. Versions paired with and similar to AERONET
  - Version 1: 2000 – 2006. Continuous 24/7 Signal data. Cloud base height, aerosol profiles at AERONET obs times.
  - Version 2: 2006 – 2016: Added multiple cloud heights, continuous day/night aerosol retrievals, PBL testing
  - Version 3: in development since 2013 …., release date Dec 2019
    - New data center and website, Polarized MPL network-wide
    - Level 1.5 NRT products now include QA (same as AERONET)
    - Data NETCDF 4, CF compliant formats. Subsets available (including SDS-WAS regions, custom sets also)
    - Greatly expanded cloud products, new PBL algorithm, new aerosol depolarization ratio

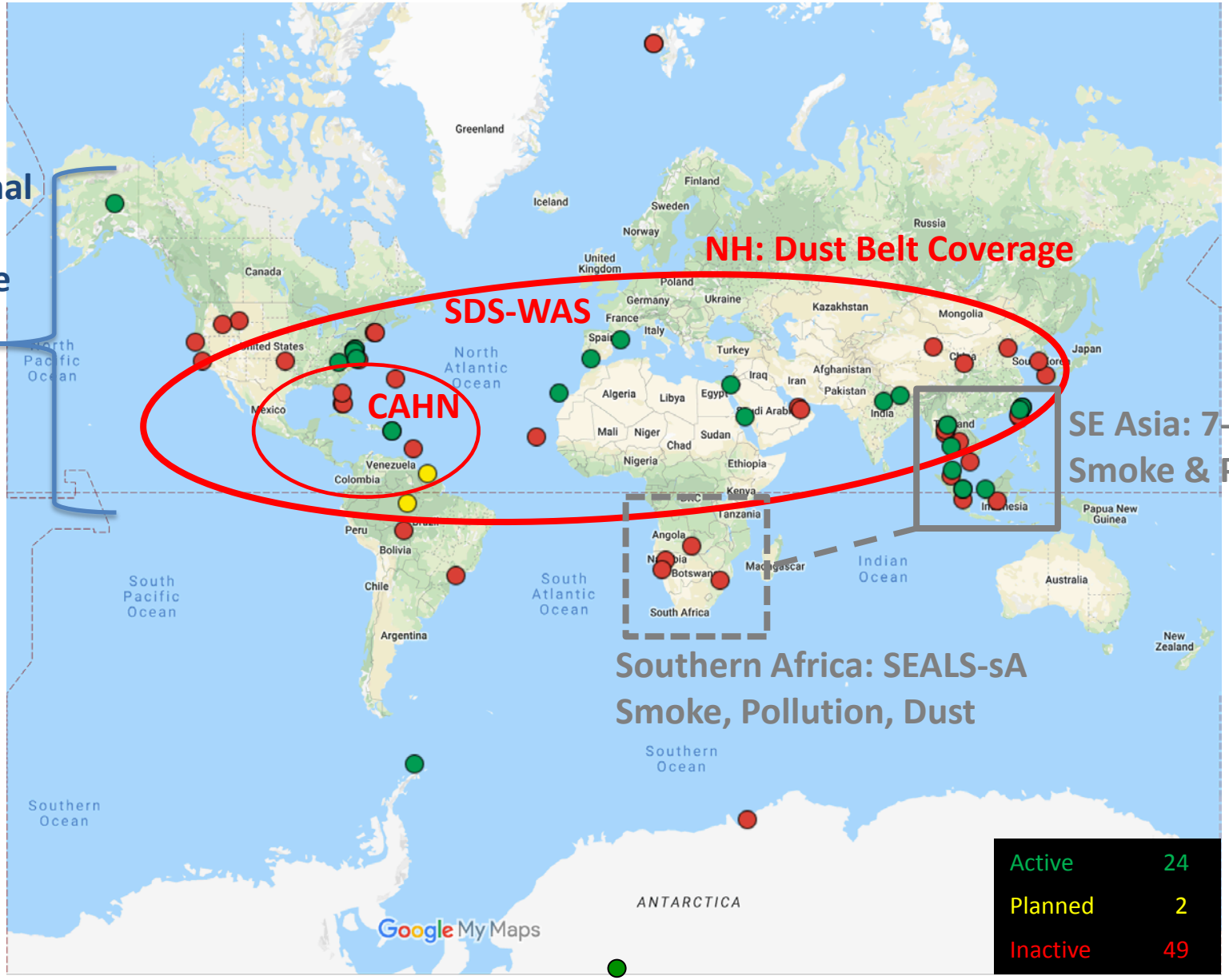
Polarized Micro Pulse Lidar



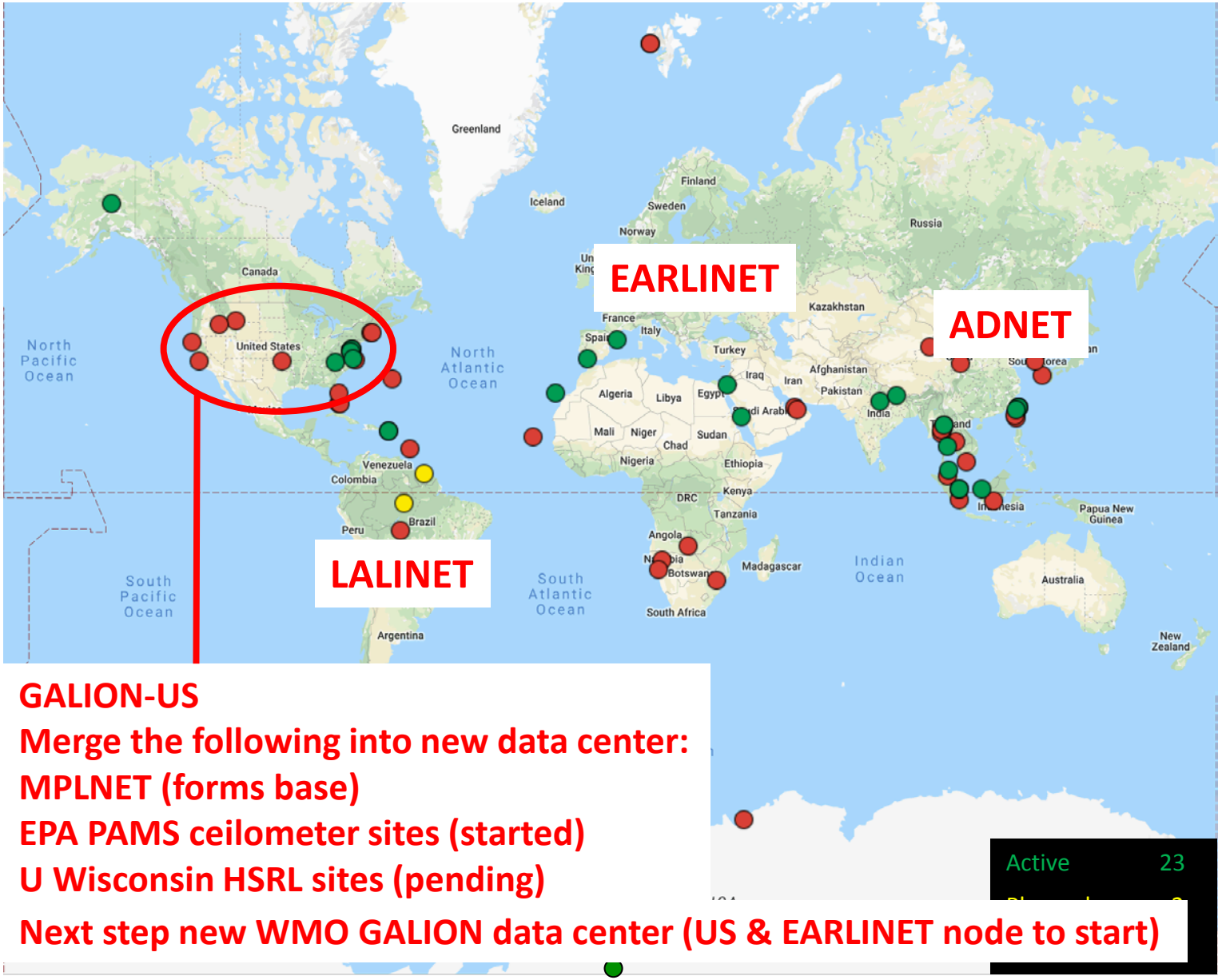
Polarized Mini Micro Pulse Lidar

Overview of MPLNET: Sites 2000 - current

Latitudinal Cirrus Radiative Impact Study



Overview of MPLNET: Sites 2000 – current + GALION



GALION-US

Merge the following into new data center:

MPLNET (forms base)

EPA PAMS ceilometer sites (started)

U Wisconsin HSRL sites (pending)

Next step new WMO GALION data center (US & EARLINET node to start)

Overview of MPLNET: Version 3 Product Suite

Detailed information on V3 Products: mplnet.gsfc.nasa.gov/product-info/

QA Screening: Confidence Levels

V3 Product	
NRB	
CLD	
AER	
PBL	
Product F	
Formats	

QA Confidence Level	Value	Descriptions
n/a	0	Only set if variable has no QA inspection applied.
High	1	Long history with variable and QA procedures results in high confidence
Moderate	2	Lower confidence in an ancillary data input results in lower overall QA confidence
Low	4	Reserved for variables that are new and require more study to elevate confidence
Fail	8	Data fail QA screen, variable data replaced with NaN

* Each data variable in all products has a corresponding QA confidence variable

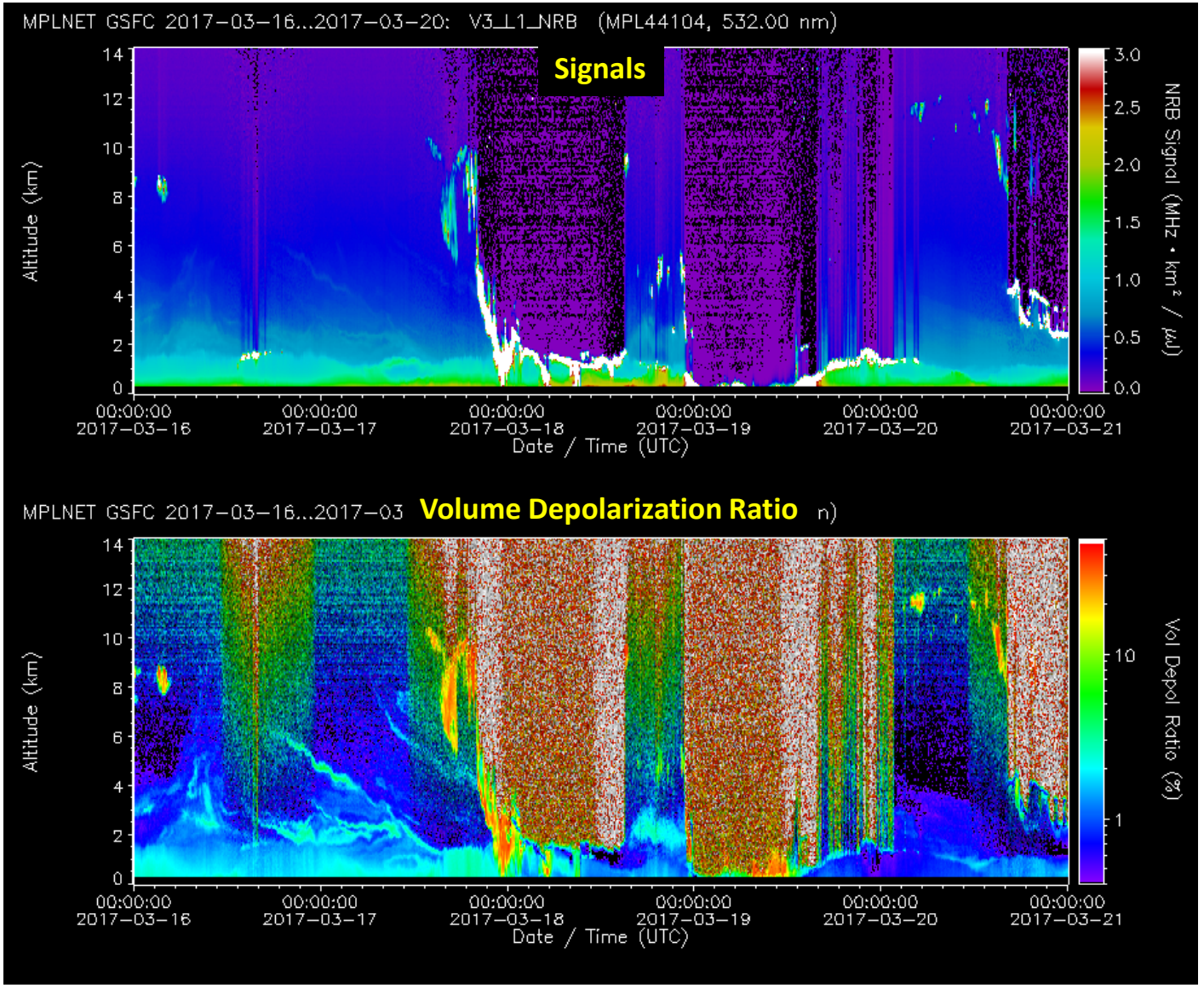
Product Levels	Availability	Calibration	QA Screen	Ancillary Input
L1_NRB L1_CLD L1_PBL L1_AER	Automated Browse: Near Real Time Download: Next Day *	intial, ongoing field calibrations	none	GEOS5 Forecast NRT, reprocessed next day with GEOS5 Assimilated, AERONET L15 AOD
L15_NRB L15_CLD L15_PBL L15_AER	Automated Browse: Near Real Time Download: Next Day *	intial, ongoing field calibrations	L15	GEOS5 Forecast NRT, reprocessed next day with GEOS5 Assimilated, AERONET L15 AOD
L2_NRB L2_CLD L2_PBL L2_AER	upon request †	intial, ongoing field calibrations, post calibration, additional‡	L2	GEOS5 Assimilated, AERONET L2 AOD

* Near real time data can be provided to site partners and forecasting/modeling centers

† L2_AER products subject to availability of L2 AERONET data

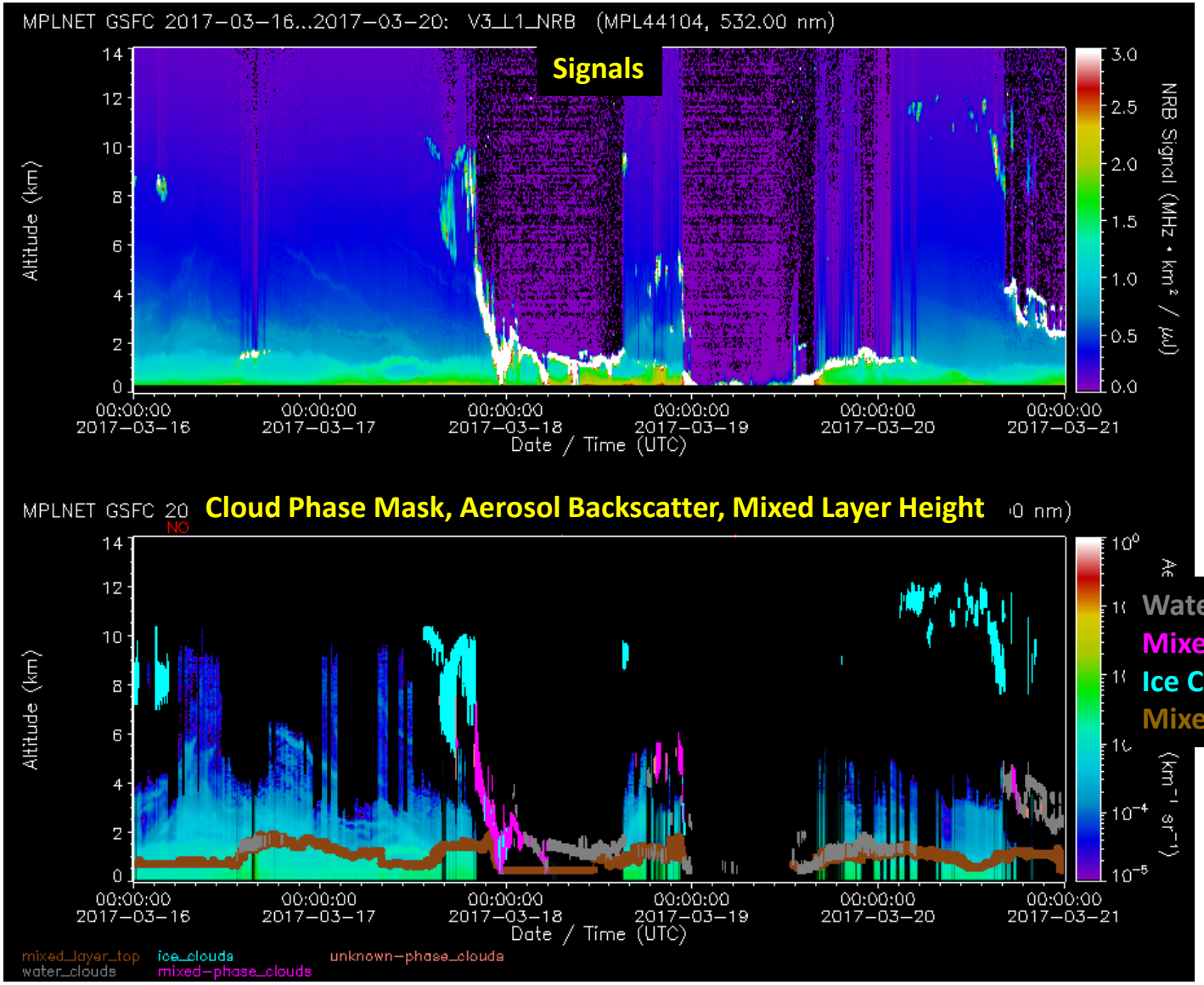
‡ Additional L2 calibrations may include corrections for instrument temperature and manual inspection of data

Overview of MPLNET: Level 1 (and L1.5) NRB Product

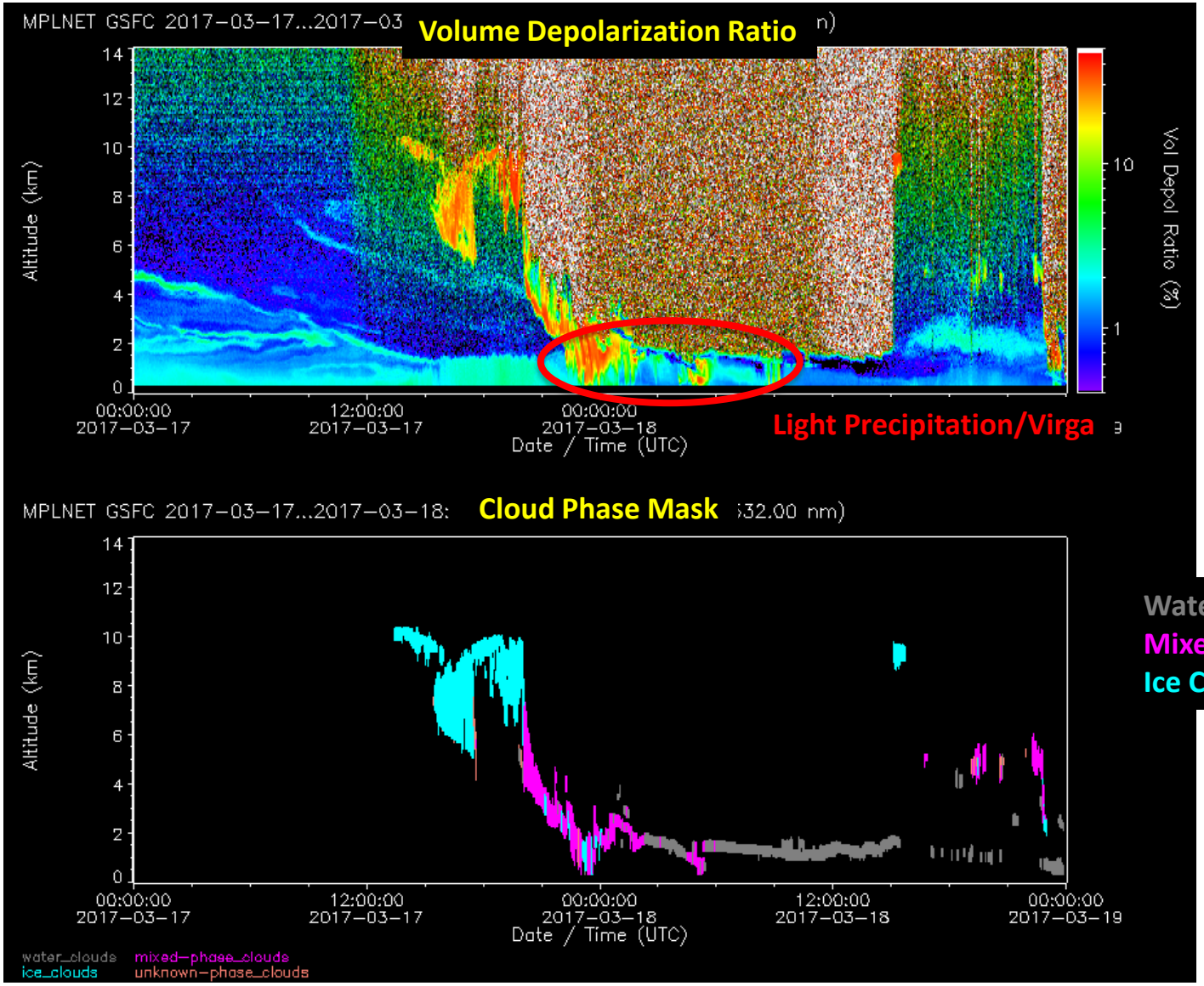


Overview of MPLNET: Level 1 (and L1.5) CLD, AER, PBL Products

Cloud, Aerosol, & PBL Product Overview

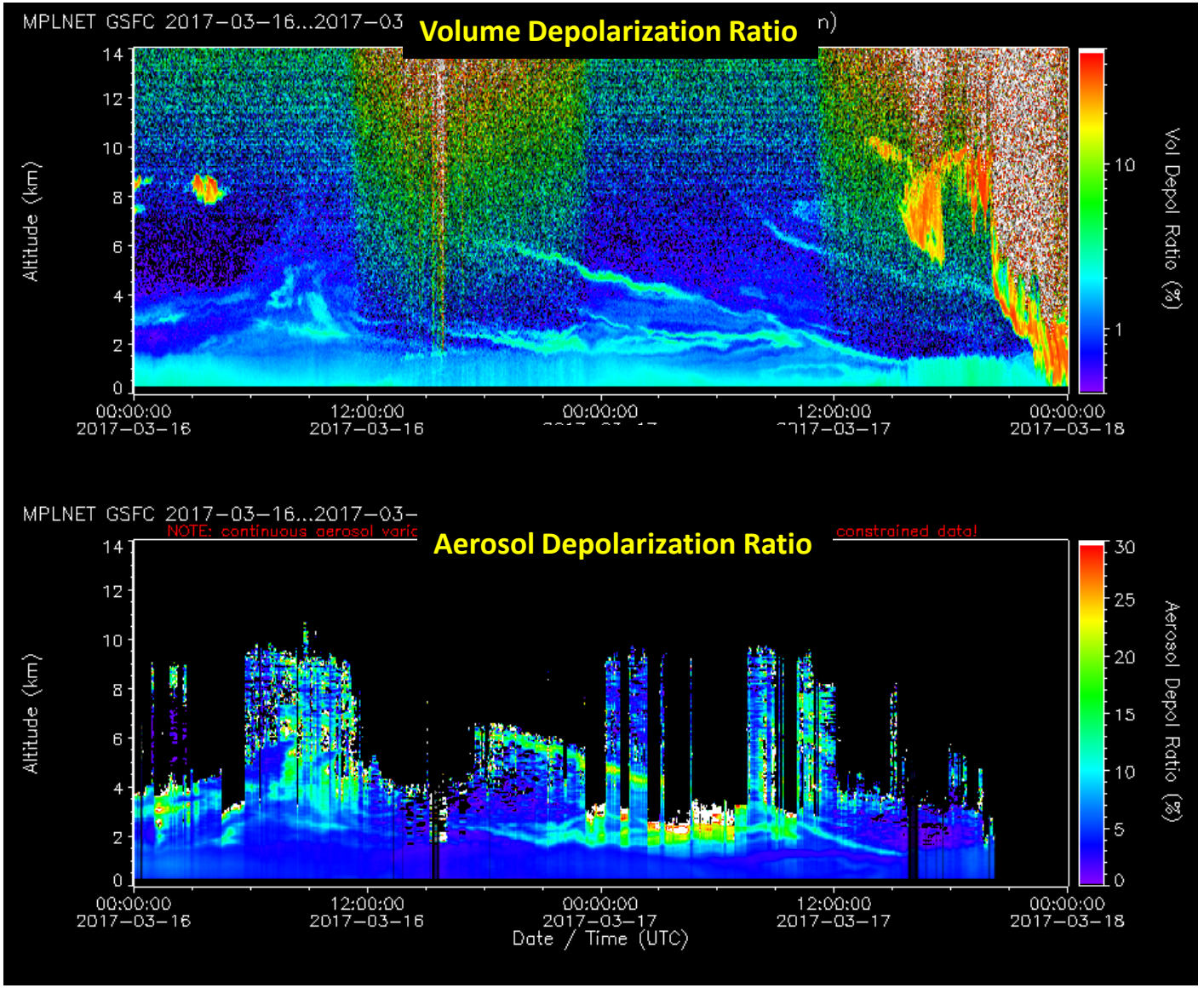


Overview of MPLNET: Level 1 (and L1.5) CLD Product



Water Clouds
Mixed Phase Clouds
Ice Clouds

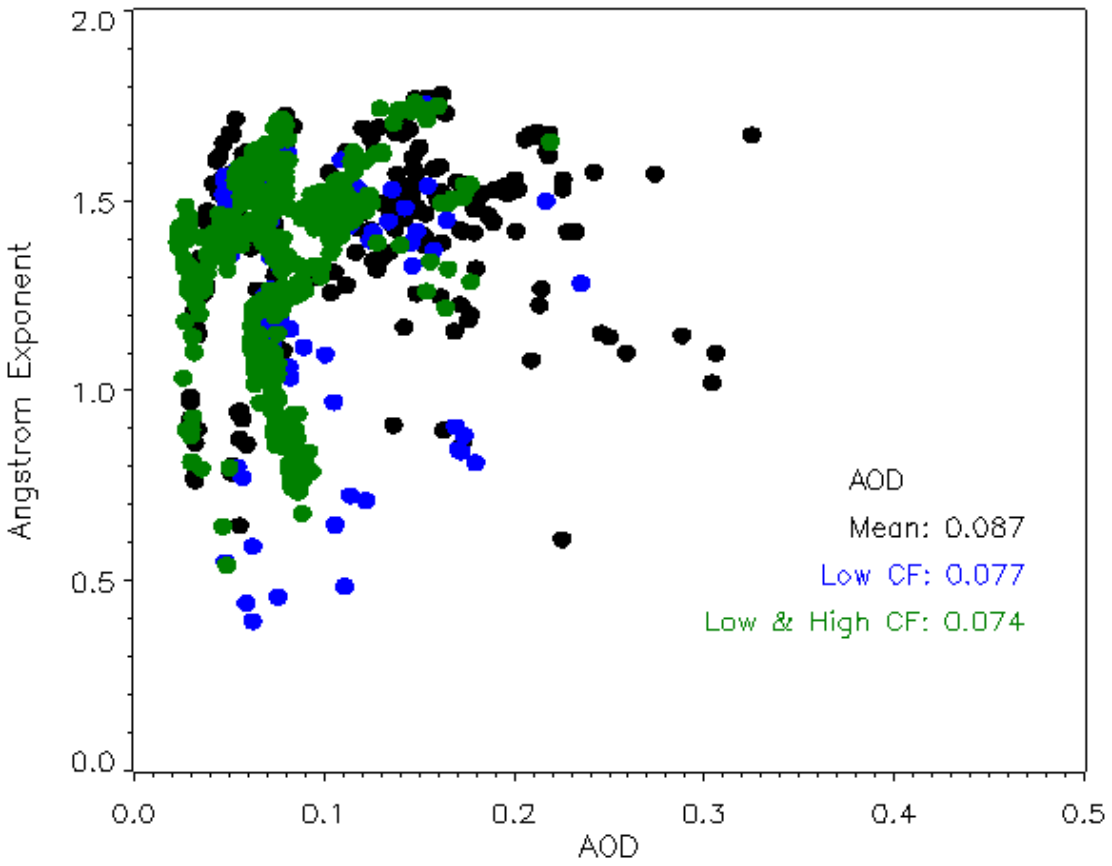
Overview of MPLNET: Level 1 (and L1.5) AER Product



AERONET Co-Located Lidar: additional cloud screening

GSFC: April 2019

Level 1.5 AOD vs Angstrom Exponent
Additional Cloud Screening from MPLNET



MPLNET Aerosol Diagnostic Variables:

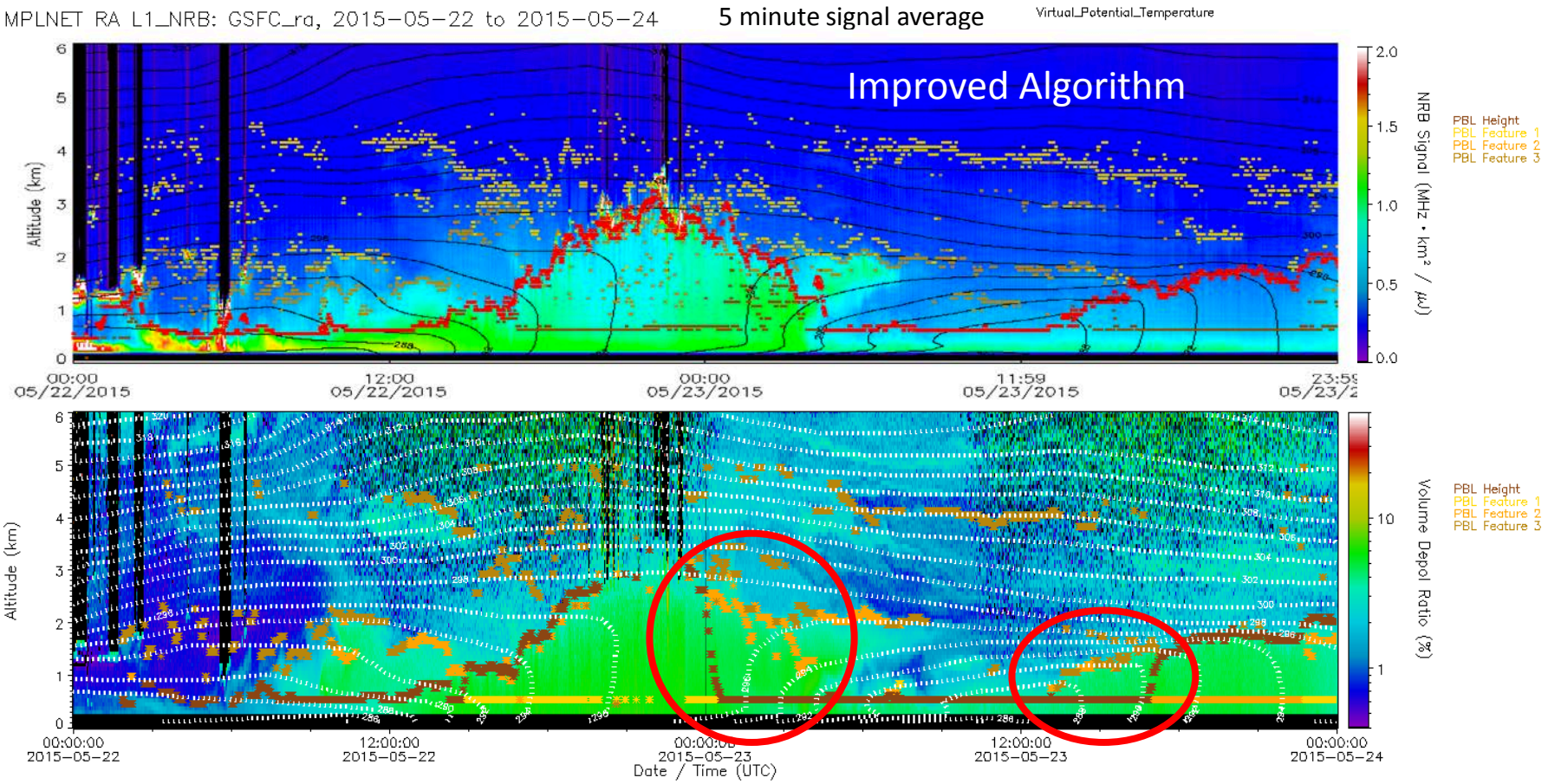
Rolling 20 minute cloud fraction
From surface to aerosol top
(gives cloud presence +- 10 mins from AERONET obs)

Cloud above aerosol top
(indicates presence of high cloud above all aerosol layers)

AERONET Only
Low Clouds Screened
Low & High Clouds Screened

If correct, this is an 18% high bias.
Even if AOD is minimally affected, microphysics could have large bias

Overview of MPLNET: Level 1 (and L1.5) PBL Product

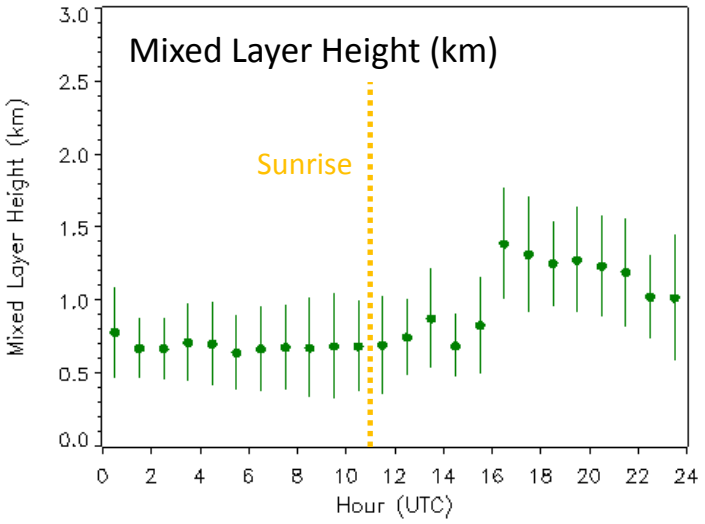


MPLNET: PBL Height product since 2008 (V2). Did not perform well enough, never officially released.
Data were provided in NRT to NCEP for a research study (testing NRT delivery)

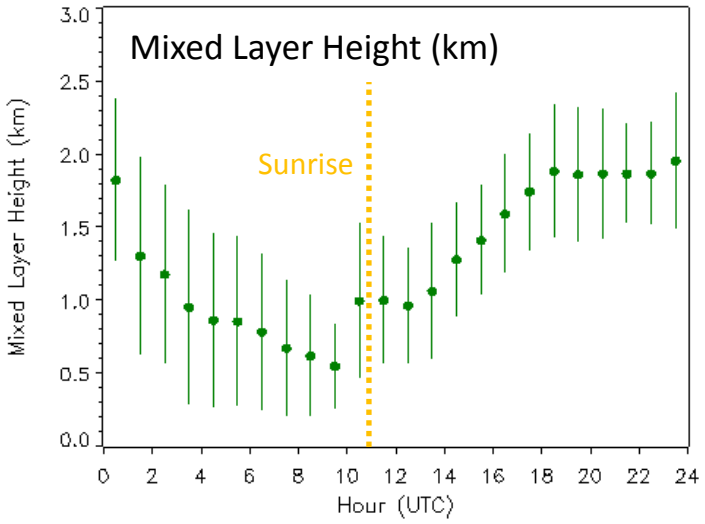
New algorithm developed for V3: Lewis et al., Improved boundary layer depth retrievals from MPLNET, JGR, 2013
Currently refining research algorithm for operational use

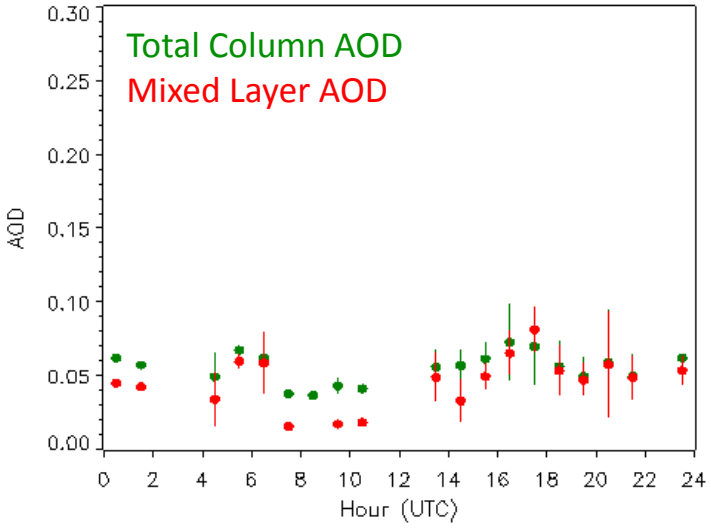
Diurnal Climatology: PBL & AOD

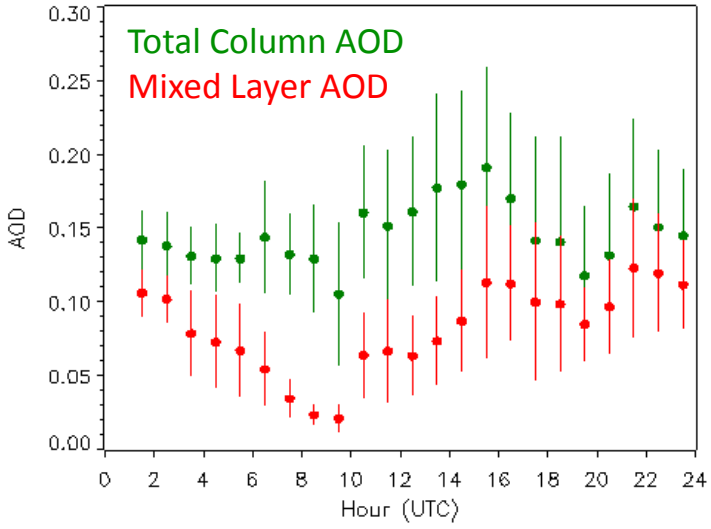
GSFC January 2019



GSFC July 2019







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MPLNET Staff
MPLNET Partners

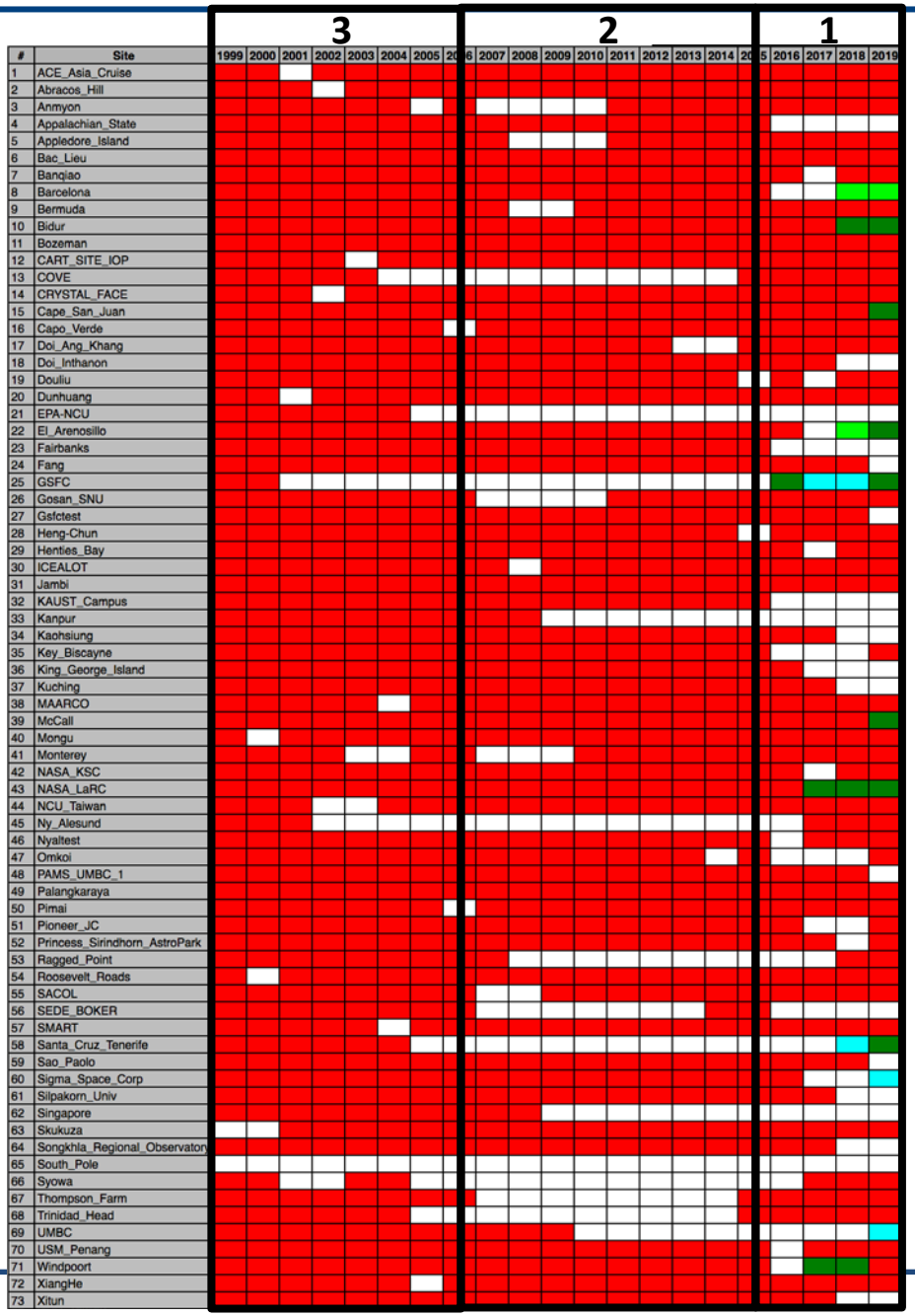
MPLNET Data Portal: V2/GSFC/Y2008/M07/D08/

use of downloaded files must follow our data policy

V2 data is being reprocessed to V3 formats. Check V2 Data Status

Name	Last modified	Size
Parent Directory		-
MPLNET_V2_L1_AER_20080708_MPL40401_GSFC.nc4	2018-10-17 20:11	25M
MPLNET_V2_L1_CLD_20080708_MPL40401_GSFC.nc4	2018-10-17 20:10	4.4M
MPLNET_V2_L1_NRB_20080708_MPL40401_GSFC.nc4	2018-10-17 20:10	6.8M
MPLNET_V2_L2_AER_20080708_MPL40401_GSFC.nc4	2018-10-17 23:26	25M
MPLNET_V2_L2_CLD_20080708_MPL40401_GSFC.nc4	2018-10-17 20:10	4.4M
MPLNET_V2_L2_NRB_20080708_MPL40401_GSFC.nc4	2018-10-17 20:10	6.8M

MPLNET V3 Reprocessing Status



3 Reprocessing Phases

1. Current era, data taken while V3 in development. Time consuming to finalize all calibrations.

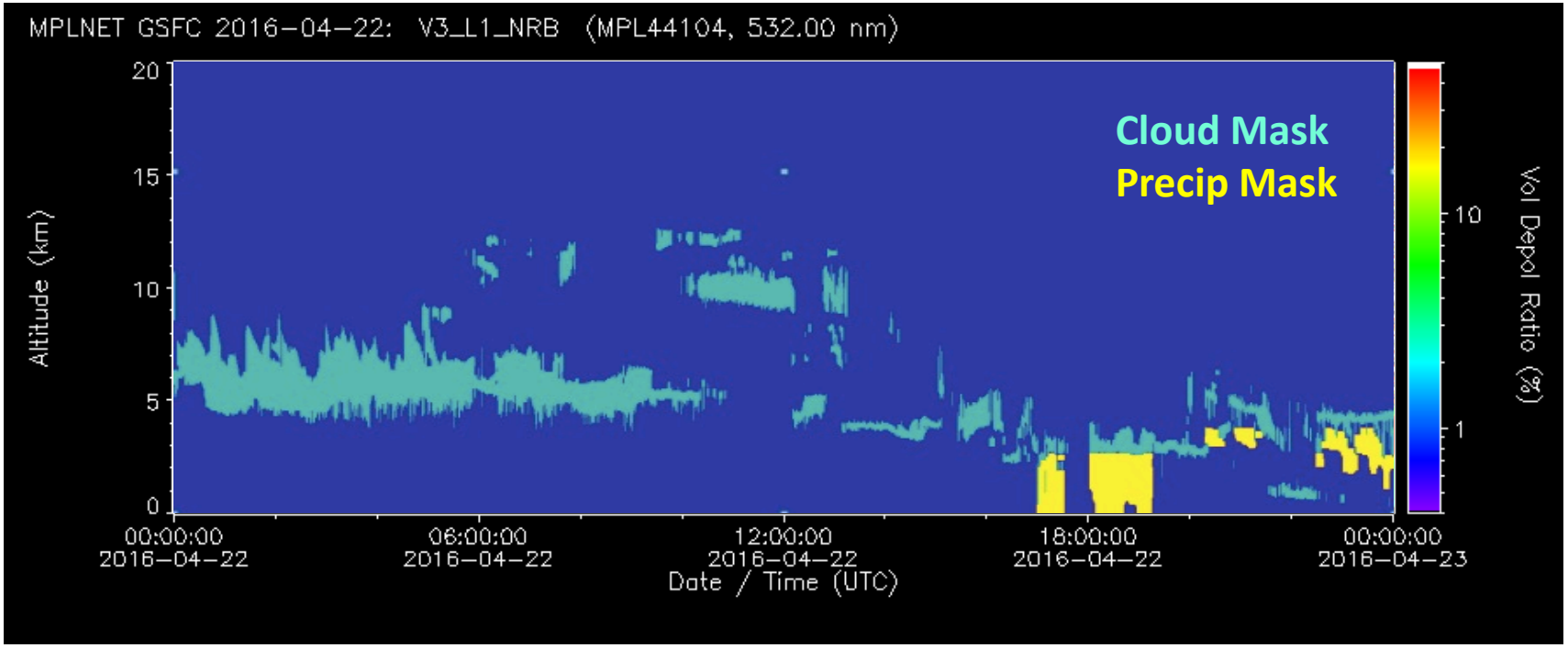
2. V2 era. Most all sites have calibrations done already. Will be easier.

3. V1 era. Many calibrations archived in V1 backup. Need to be located and transformed to V3 format, then reprocessed.

MPLNET Research to Ops: aerosol-cloud interactions

Detection of light precipitation (below typical radar detection capability)

- Contribution to wet deposition for frequent light rain events
- aerosol processing at cloud base
- Series of papers published on estimating rain drop size & rain rate

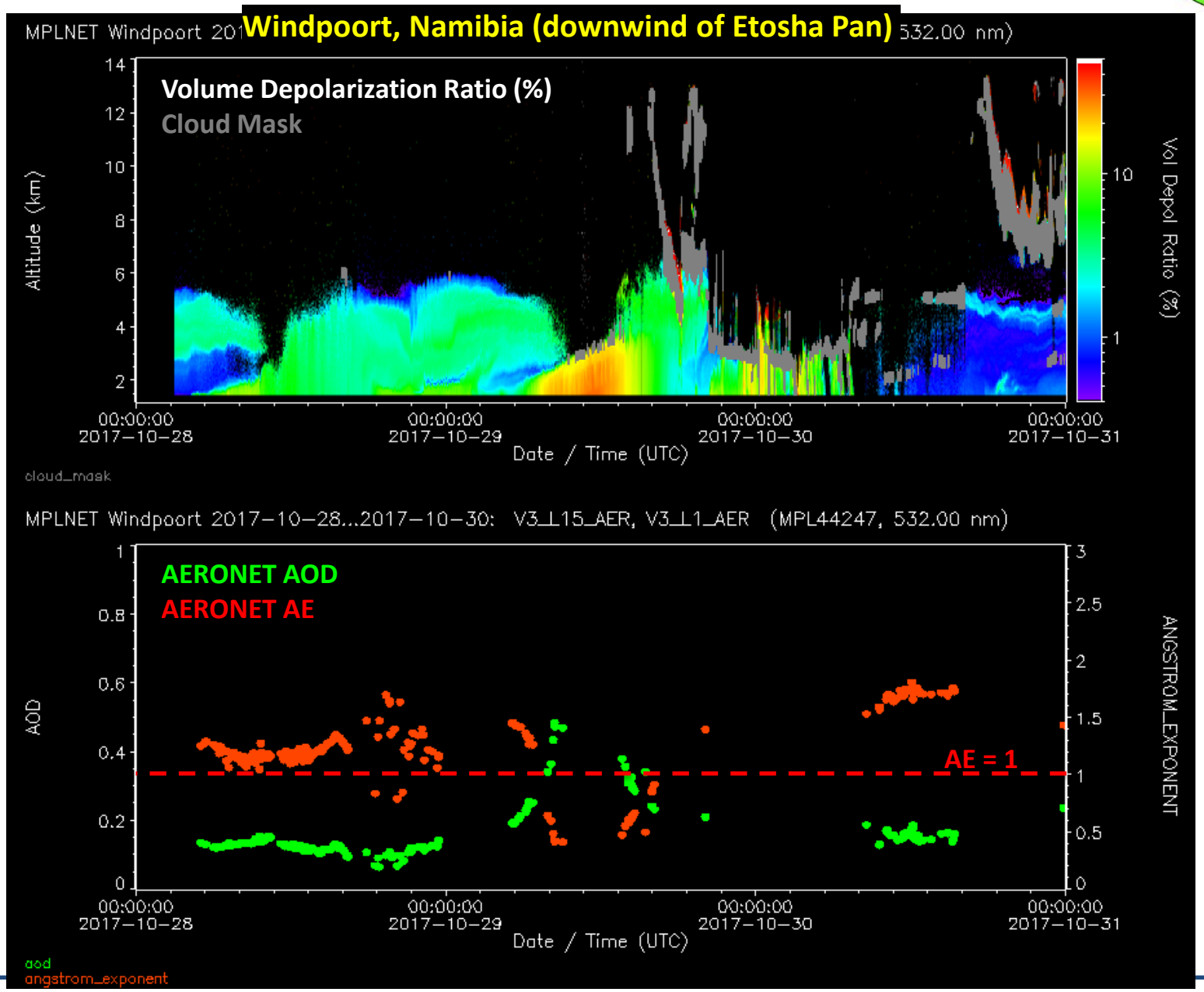


Lolli, et al., JTECH, 2013.
Lolli, et al, JTECH, 2016.
Lolli, et al, Remote Sens., 2018.

} Series of papers on proof of concept
Rain drop size & rain rate

Next paper on operational precipitation detection and mask

MPLNET Scene Classification: metadata tags for AERONET?



conclusion

WMO GAW Aerosol Lidar Observation Network (GALION)

WMO GAW Aerosol Lidar Observation Network (GALION):
A lidar network of networks organized through the GAW program, and is composed primarily of the world's leading lidar networks. Each is an official contributing network to GAW (or soon will be).

GALION Networks:
EARLINET
AD-NET
CIS-LINET
LALINET
CORALNET
CREST
MPLNET (global)
NDACC (global)

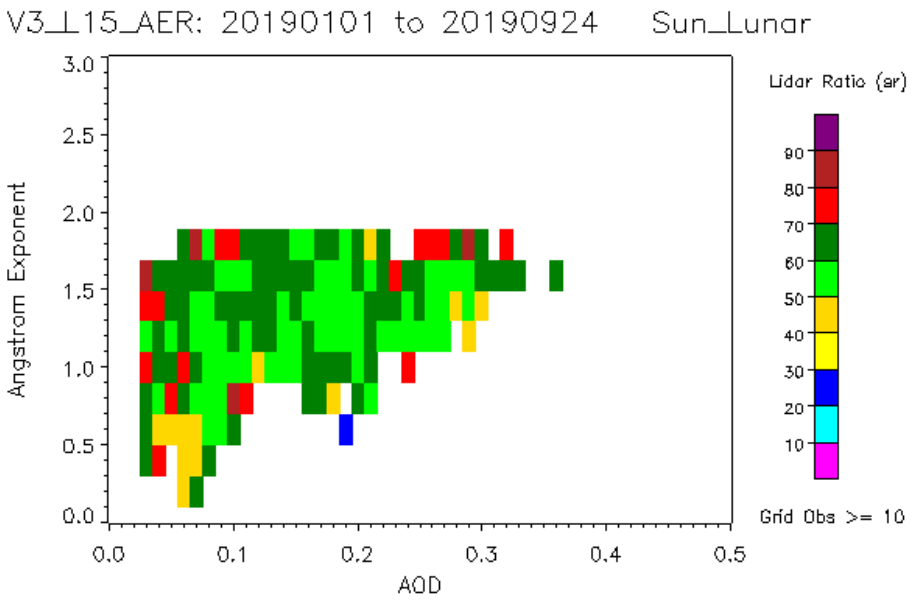
GALION Co-Chairs:
Gelsomina Pappalardo (CNR IMAA)
Ellsworth J. Welton (NASA)

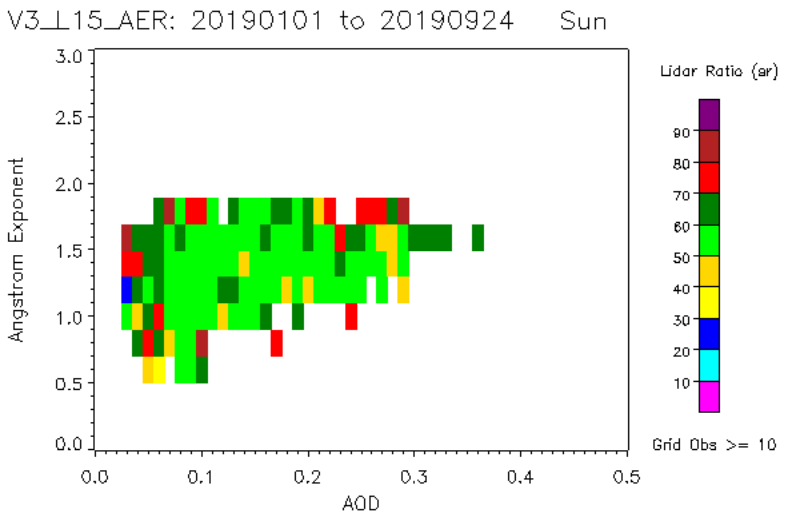
Work Groups:
Calibration, QA/QC, processing/products, applications, data center

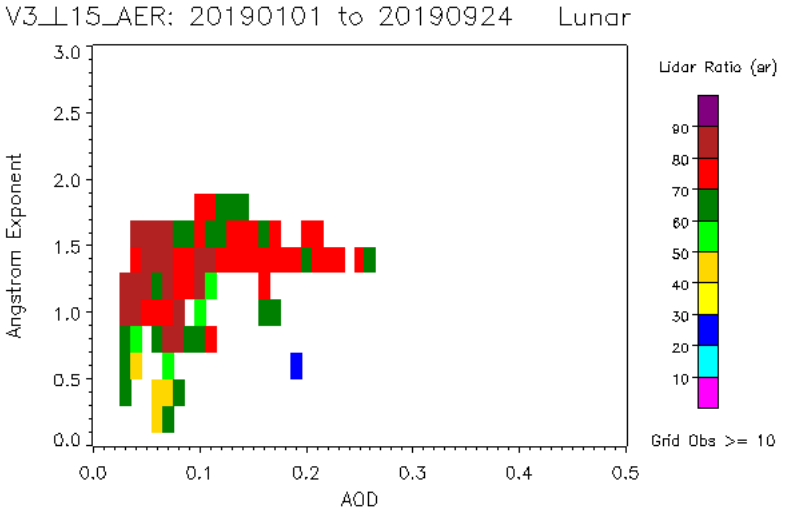
Map is a few years old at this point …

Diurnal Climatology: Aerosol Properties Day vs Night

(Lunar AERONET provisional)







Unclear right now why Lunar is different:

Lidar ratios over 70 sr are suspect

Could be high bias in lunar AOD

a 15-20% bias would account for lidar ratio difference

A lot of smoke and volcanic transport this year

Nighttime data more sensitive to weak high layers

Could shift the lidar ratio towards higher values

Calibration bias in lidar (unlikely given new V3 process)

Overview of MPLNET: Version 2 Update

Summary: Version 2 Data Period 2000 – mid 2016

- All V2 data files have been translated to V3 file formats and structure (including new QA flags)
- V2 data now archived within V3 processing system
  - V2 data browsing and delivery integrated into V3 website
- V2 data files available from new online V3 data portal
- Some data were not downloadable: no final calibrations or some other problem
  - It may be possible to recover these data when we reprocess older data in V3

Version 2 Data Statistics:

Product	Days	Downloadable
L1_NRB:	44,431*	17,711
L1_CLD:	15,210	same
L1_AER:	7,627	same
L2_NRB:	10,956	same
L2_CLD:	10,821	same
L2_AER:	4,618	same

* 63,980,640 signal profiles
9.6 trillion laser shots