



# The Evolution of Lidar Networks: a US perspective

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NASA Micro Pulse Lidar Network (MPLNET)

Windpoort, Namibia

Photo: Seb Stewart



## Introduction: Some Constraints for the Discussion

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- Focus on atmospheric lidars providing cloud and aerosol profile data (should have altered title)
- Ceilometers vs Lidar
  - Similar design, here we consider only instruments providing signal profile data
  - Various met agencies have run ceilometer networks for a long time
    - Historically they were limited to providing cloud base height, no signal profiles
  - Newer ceilometers now provide profiling, and are incorporated into networks
    - DWD – Germany, E-PROFILE (EU)

Ground based lidar R&D progressed rapidly from the 1980s to 1990s

- Laser and detector technology led to improvements in data quality and ability to operate for extended periods
- Retrieval techniques matured

Multi-Disciplinary Programs create networks for earth data observations

- DOE Atmospheric Radiation Measurement (ARM) network
- Network for the Detection of Atmospheric Composition Change (NDACC)
- Both networks provide lidar profiling capability, but not dedicated lidar networks

Success of the NASA Aerosol Robotic Network and WMO Global Atmospheric Watch (GAW) in-situ aerosol network proved value of long-term aerosol monitoring

- In 1999-2000 three dedicated aerosol lidar networks were created, independently
  - NASA Micro Pulse Lidar Network (MPLNET)
  - Asian Dust and Aerosol Lidar Observation Network (AD-NET)
  - European Aerosol Research Lidar Network (EARLINET)



# The NASA Micro Pulse Lidar Network (MPLNET)



2000 – current

Homogenous instrumentation

Commercial Micro Pulse Lidar (MPL)

elastic backscatter 532 nm, polarized

Network: Over 70 sites, ~20 currently active

Global distribution

Objective: provide lidar profiling at NASA AERONET sites

Co-location & partnership with AERONET

Sparse regional coverage (esp North America)

Data Processing:

MPLNET Calibration Center: GSFC

working on calibration device for field sites

Centralized & Standardized Processing: GSFC

NETCDF-4

Signal, Cloud, Aerosol, and PBL Products (L1, L1.5, L2)

Online data browsing (public)

Online data download (public)

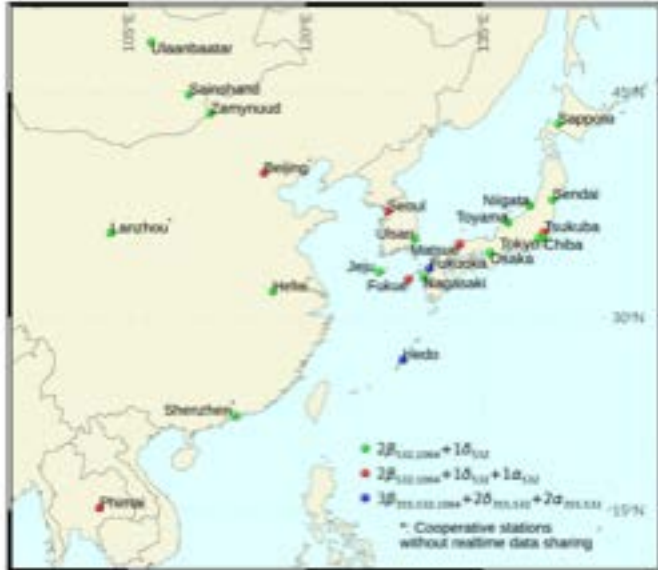
near real time online delivery (~ 1 hour)

NASA funded, with contributions from international partners



# The Asian Dust and Aerosol Lidar Observation Network (AD-Net)

## AD-Net



2000 – current

Homogenous instrumentation

NIES Dual Wavelength Backscatter lidar

elastic backscatter 1064 & 532 nm, polarized

Some now have raman capability

Network: 20 sites

Dense regional coverage over East Asia

Data Processing:

Calibration Center: NIES

Centralized & Standardized Processing: NIES

NETCDF

Signal, depolarization, extinction, cloud/rain flags

Online data browsing (public)

Online data download (public)

near real time online delivery

Significant progress with model assimilation of AD-Net Data

Asian Dust forecasting

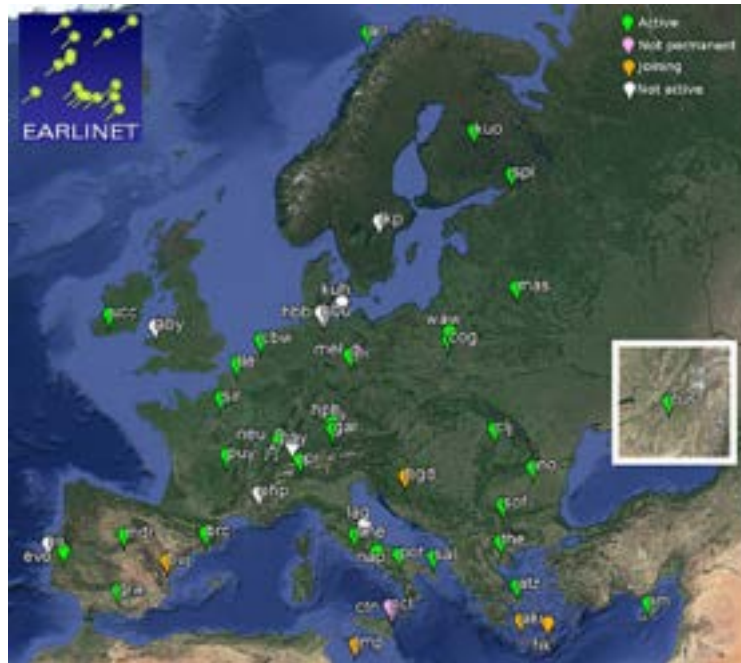
Supported by Japanese Ministries of Environment and Education



# The European Aerosol Research Lidar Network (EARLINET)

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2000 – current



Heterogenous instrumentation

From basic elastic backscatter to  
multi-wavelength & polarized raman lidars

Network: over 30 sites

Dense regional coverage in Europe

Some sites globally

Data Processing:

Decentralized at first

Have since solved issues running heterogenous network

Lidar Calibration Center Established

Instrument training, standards, & calibration

Centralized & Standardized Processing & Products

Single Calculus Chain (SCC)

NETCDF-4

Online data browsing (public)

Online data download (login required)

A few sites have NRT capability

many still only have a few obs per week

Advanced aerosol retrievals (have set standards)

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Currently supported under ACTRIS program



These three networks + ARM & NDACC have common traits for success:

- Strong emphasis on calibration and quality control processes
- Centralized processing for standardization, traceability, and QA
- Core funding
- Multi-disciplinary science focus, integration with research community
  - Leads to strong publication history and data usage

EARLINET and AD-Net are regional networks with strong core funding

- these projects coalesced ground lidar activities in their regions
- end result is a mature, dense lidar network for these areas

MPLNET, ARM, and NDACC have a global focus

- No mandate to coalesce ground lidar work, nor provide dense network for USA/NA
- Ex: MPLNET was created to provide profiling at key AERONET sites worldwide
- Despite US funding of these efforts:
  - sparse coverage in North America
  - disparate ground lidar activities and fractured network projects in development
  - Very little or no interaction

**Until 2008, these issues extrapolate globally.**

**No one network provides dense global coverage.**



# WMO Global Atmospheric Watch (GAW) Aerosol Lidar Observation Network (GALION)

## WMO GAW Aerosol Lidar Observation Network (GALION):

A lidar network of networks organized through the WMO Global Atmospheric Watch (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).

See GAW Report 178 (2008)

### 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)

### Steering Committee:

Network Heads, GAW Leadership

### Work Groups:

Calibration, QA/QC, processing/products, applications, data center

### Successes:

- More frequent interaction between the networks
- Some joint planning
- Development of standards for lidar types/models: calibration, processing, products
- Subsequent creation of newer networks (e.g. LALINET)
- Integration with related WMO & GAW projects:
  - SDS-WAS: Sand and Dust Storm Warning and Advisory System
  - World Data Centers: current plan is to build GALION data center for lidar networks



Not complete site listing  
From WMO GAW SIS Database



## Lidar Network Developments After the Creation of GALION:

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Regional networks within Europe after Eyjafjallajökull Eruption in 2010:

- Led to significant enhancement of EARLINET and funding stability
- Several met services upgrade ceilometer networks or create lidar networks
  - DWD, KNMI, UK, France, Spain, etc
- EUMETNET creates E-PROFILE
  - Includes Europe-wide ceilometer and lidar sites
  - Address use of commercial ceilometers to provide lidar-like data

North America:

- TOLNET (Ozone lidar network, connection to NDACC)
- Univ of Wisconsin HSRL network (global)
- NYS Mesonet (some sites have lidar)
- EPA PAMS (E-PAMS) (some sites have ceilometers)
- New Canadian lidar network

I may be missing some, new efforts keep growing ....

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## North American Ceilometer & Lidar Networks Situation:

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First, we must recognize the successes of older and newer lidar networks..... **BUT**

MPLNET: mature lidar network but sparse coverage  
NWS: ceilometers, no signal profiles (as of now)  
E-PAMS: new, some ceilometers (mix)  
NYS Meso: some lidars, NY only  
UW HSLR: advanced lidar, sparse regional coverage  
TOLNET: ozone and aerosol data, sparse coverage  
CREST: education focus, sparse coverage  
CORALNET: dismantled several years ago  
New CA Net: new, currently sparse coverage

Common Theme:

Sparse coverage individually, but if combined provide dense network

Networks may benefit from experience of long running GALION networks and E-PROFILE

Suggestion: we meet to develop a framework to work together

Following slides demonstrate aspects of a mature lidar network

Using MPLNET as example

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# MPLNET: new Version 3 processing system (result of 20 years of network experience learned the hard way)

**MPLNET V3 Data:**

#	Site	Latitude	Longitude	Altitude	AERONET Site	Version	Status	Listed	Principal Investigator
<b>Active Sites</b>									
1	Aspen/Aspen State	38.2150°N	81.8947°W	1 080 km	Aspen/Aspen State	V3 Only	Active	Yes	James Sherman
2	Barcelona	41.3880°N	2.1170°E	0 126 km	Barcelona	V3 Only	Active	Yes	Josef M. Baldridge
3	Cape San Juan	18.3010°N	65.8187°W	0 015 km	Cape San Juan	V3 Only	Active	Yes	Dpa Mavor
4	El Arco/El Arco	37.1050°N	8.7340°W	0 058 km	El Arco/El Arco	V3 Only	Active	Yes	Margarita Yela Gonzalez
5	EPA/NCU	24.3670°N	121.1810°E	0 136 km	EPA/NCU	V2 & V3	Active	Yes	Carlo Weng
6	Fairbanks	64.8590°N	147.8480°W	0 300 km	Borovinka Creek	V3 Only	Active	Yes	Judit Welfter
7	GSFC	38.8900°N	76.8480°W	0 080 km	GSFC	V2 & V3	Active	Yes	Judit Welfter
8	Kaohsiung	22.8790°N	120.2800°E	0 018 km	Kaohsiung	V3 Only	Active	Yes	Carlo Weng
9	KAUST-Campus	22.3040°N	38.1100°E	0 011 km	KAUST-Campus	V3 Only	Active	Yes	Georgiy L. Stetsko
10	King George Island	52.3000°S	58.8660°W	0 000 km	-	V3 Only	Active	Yes	Raul Cordes
11	NASA LaRC	37.1050°N	75.2780°W	0 508 km	NASA LaRC	V3 Only	Active	Yes	Greg Schuster
12	Phoson, Shingon, Amal/Park	18.8100°N	98.8980°E	0 300 km	Chung Mai Mat. Sta	V3 Only	Active	Yes	Ronald Muckenroy
13	Santa Cruz, Tenerife	28.4700°N	16.2470°W	0 060 km	Santa Cruz, Tenerife	V2 & V3	Active	Yes	Margarita Yela Gonzalez
14	SEIZ-BOKER	30.8660°N	24.7800°E	0 480 km	SEIZ-BOKER	V2 & V3	Active	Yes	Armen Karadz
15	Sisakon, Univ	13.8190°N	100.0410°E	0 070 km	Sisakon Univ	V3 Only	Active	Yes	Judit Welfter
16	Singapore	1.2980°N	103.7800°E	0 000 km	Singapore	V2 & V3	Active	Yes	Boo-Chul Lee
17	Sorghata Regional Observatory	7.1580°N	100.8100°E	0 108 km	Sorghata Mat. Sta	V3 Only	Active	Yes	Ronald Muckenroy
18	South Pole	89.9500°S	24.8000°W	2 835 km	South Pole	V2 & V3	Active	Yes	Judit Welfter
19	UMBC	38.2050°N	75.7100°W	0 040 km	UMBC	V2 & V3	Active	Yes	Ruben Delgado
20	Xitun	24.1680°N	120.8170°E	0 084 km	Xitun	V3 Only	Active	Yes	Carlo Weng
<b>Inactive Sites</b>									
1	Abricos Hill	10.7907°S	82.2667°W	0 280 km	Abricos Hill	V2 & V3	Inactive	Yes	Judit Welfter
2	ACE Asia Cruise	-	-	0 000 km	ACE Asia Cruise	V2 & V3	Inactive	Yes	Judit Welfter
3	Armeer	38.8300°N	126.2187°E	0 048 km	Armeer	V2 & V3	Inactive	Yes	Myoung-Goo Kim

Easy, public online data browsing and data download

With data center interoperability (links to other data centers)

Data product descriptions, file formats, variable and flag documentation (peer-review papers & online ATBD)

Processing & Calibration Traceability

Publication lists with citations for each topic area

### Management:

- Secure data communications
- Well maintained, detailed metadata database
  - instrument tracking
  - calibration histories
  - site information
  - data availability
- Real time instrument health & data quality tracking & alerts
- Multi-threaded processing system with logging and control app
  - Web based ideal



# Overview of MPLNET: Version 3 Product Suite

Detailed information on V3 Products: [mplnet.gsfc.nasa.gov/product-info/](http://mplnet.gsfc.nasa.gov/product-info/)

V3 Product		QA Screening: Confidence Levels	
	QA Confidence Level	Value	Descriptions
<a href="#">NRB</a>	n/a	0	Only set if variable has no QA inspection applied.
<a href="#">CLD</a>	High	1	Long history with variable and QA procedures results in high confidence
<a href="#">AER</a>	Moderate	2	Lower confidence in an ancillary data input results in lower overall QA confidence
<a href="#">PBL</a>	Low	4	Reserved for variables that are new and require more study to elevate confidence
<b>Product F</b>	Fail	8	Data fail QA screen, variable data replaced with NaN
<a href="#">Formats</a>			

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

Product Levels	Availability	Calibration	QA Screen	Ancillary Input
L1_NRB	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
L1_CLD				
L1_PBL				
L1_AER				
L15_NRB	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
L15_CLD				
L15_PBL				
L15_AER				
L2_NRB	upon request †	intial, ongoing field calibrations, post calibration, additional‡	L2	GEOS5 Assimilated, AERONET L2 AOD
L2_CLD				
L2_PBL				
L2_AER				

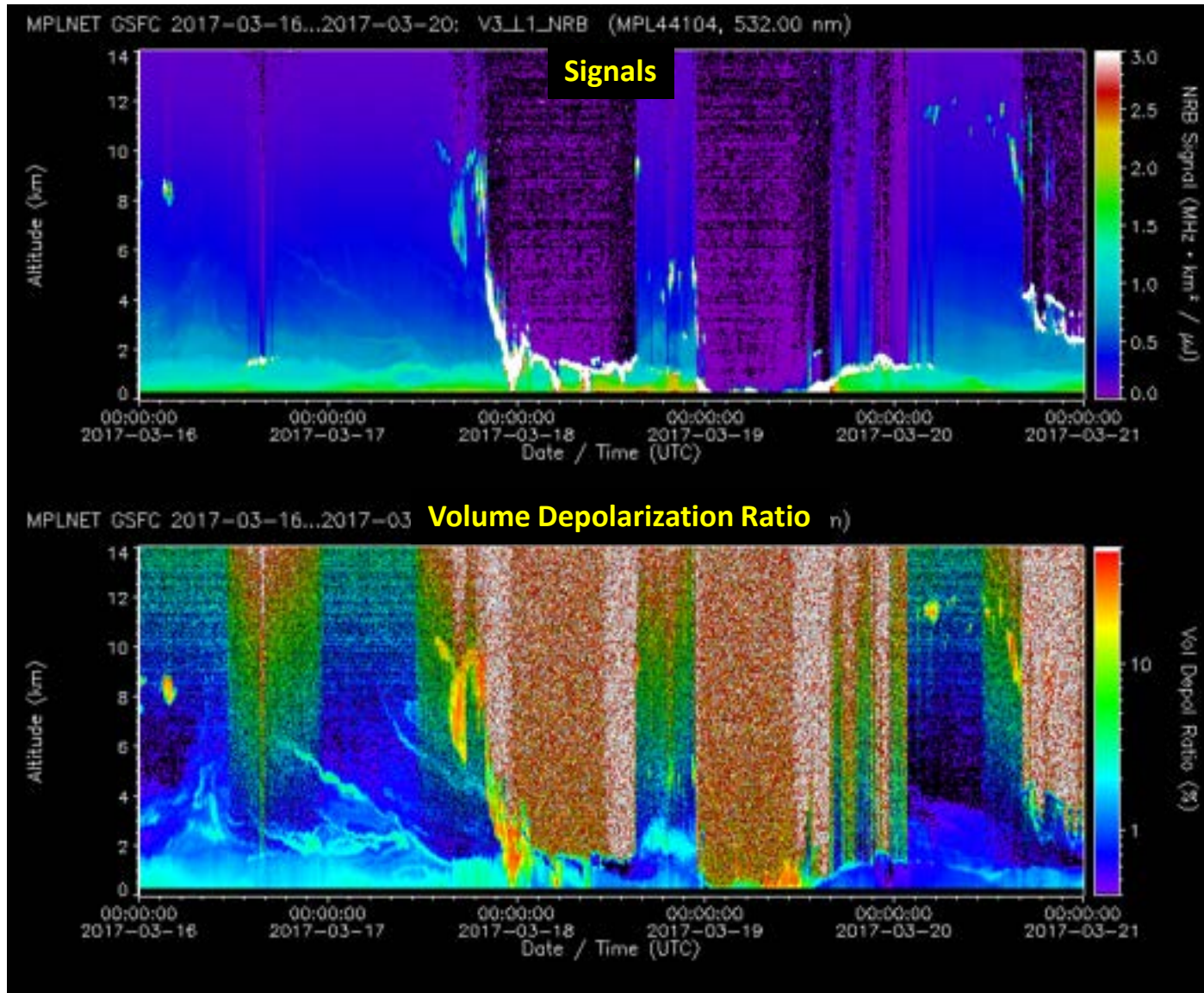
\* Near real time data can be provided to site partners and forecasting/modeling centers

† L2\_AER products subject to availability of L2 AERONET data

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

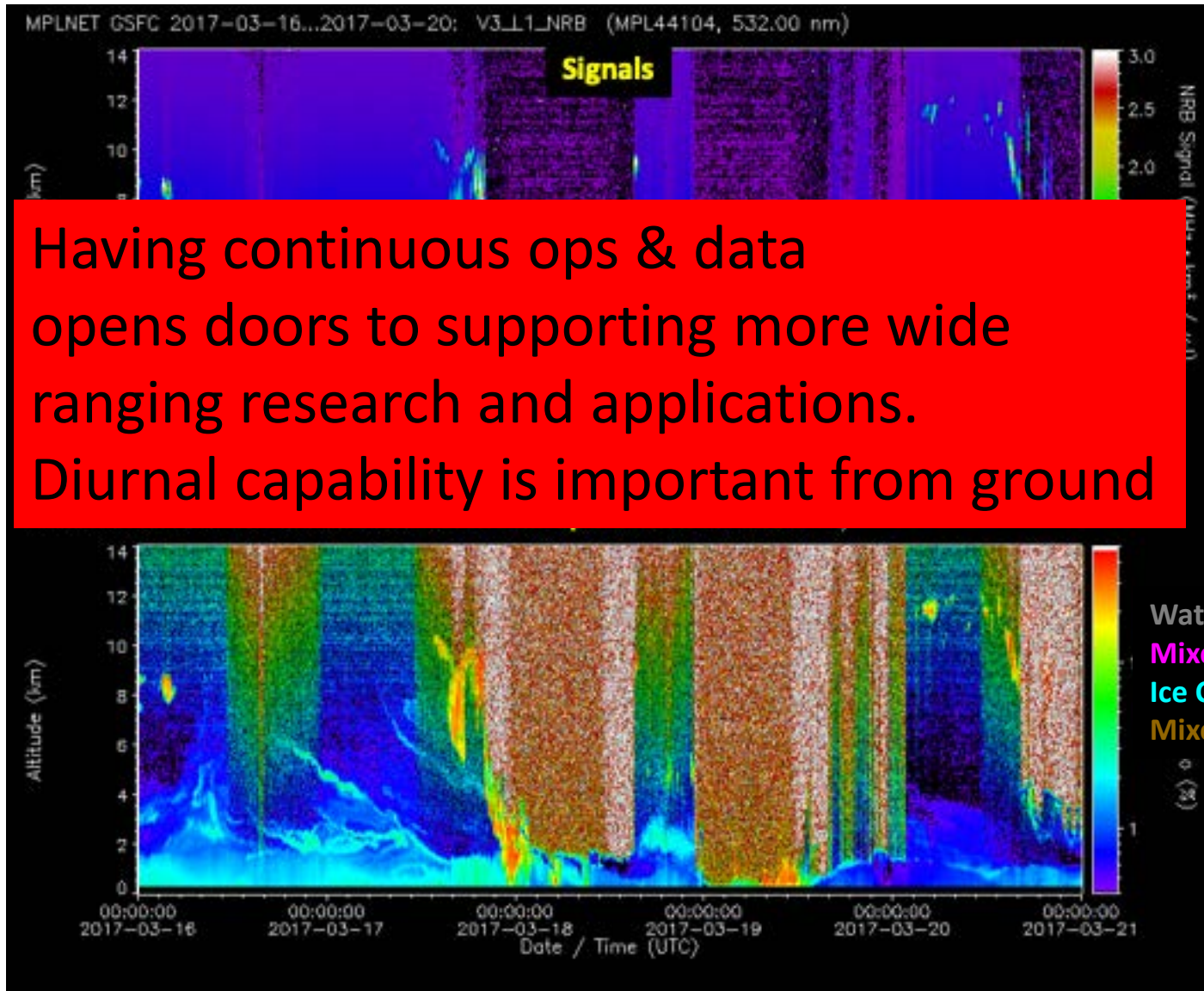


# Overview of MPLNET: Level 1 (and L1.5) NRB Product. (Signals and Diagnostics)





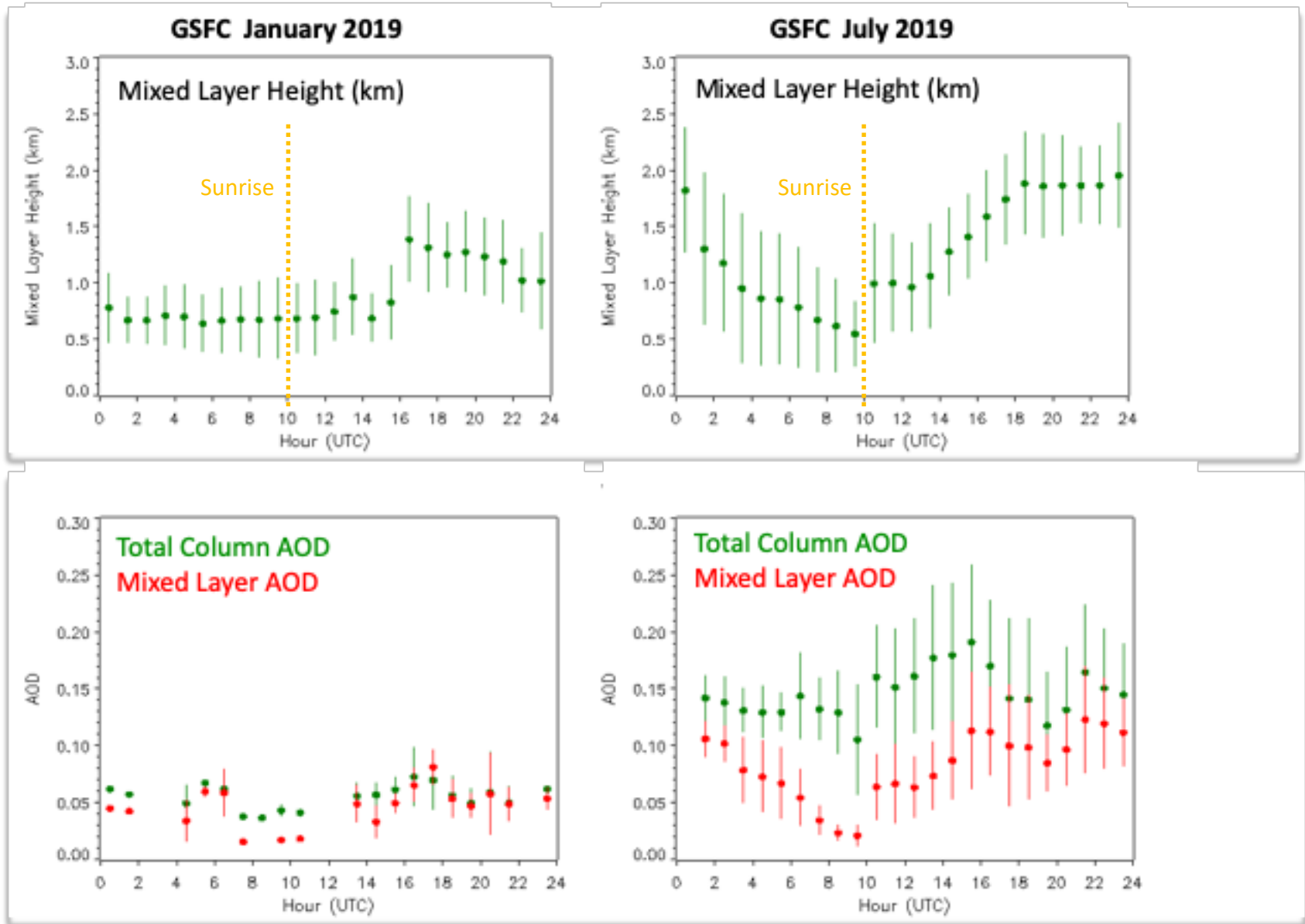
## Cloud, Aerosol, & PBL Product Overview






# Overview of MPLNET: Long term, continuous sites lead to Diurnal Climatologies

Ground data play a key role as most satellite obs do not provide diurnal information. None do with profiling.






# New MPLNET Site Page: Site contacts & metadata



National Aeronautics and Space Administration  
Goddard Space Flight Center

## MPLNET Sites



Micro-Pulse Lidar Network

Show Active Periods  Show Public Sites  Go

Home  
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Browse V3 Data  
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MPLNET Staff  
MPLNET Partners

Active  
Inactive  
Cat: All  
Cat: Active  
Cat: Inactive

----- Collections -----  
 CAMPAIGNS: 7SEAS  
 CAMPAIGNS: CARM  
 ICAP: NOSEA  
 ICAP: BYZANTIUM  
 ICAP: EASTASIA  
 ICAP: SUBTROPATL  
 ICAP: PACIFIC  
 ICAP: CONUS  
 ICAP: SATLANTIC  
 ICAP: SOALUS  
 ICAP: NPOLAR  
 SDS: NAMEE  
 SDS: EASTASIA  
 SDS: PANAM  
 DUSTBELT  
 NAAPS

----- Sites -----  
 ACE\_Ark\_Cruise  
 Abracos\_Hill  
 Arnyon  
 Appalachian\_State  
 Appleton\_Island  
 Bac\_Lieu  
 Bangiao  
 Barcelona  
 Bermuda  
 Bidar  
 Bozeman  
 CART\_SITE\_JOP  
 COVE  
 CRYSTAL\_FACE  
 Cape\_Ser\_Juin  
 Cape\_Verte  
 Doi\_Ang\_Khang  
 Doi\_Inthanon  
 Doulu  
 Dunhuang  
 EPA-NCU  
 EL\_Arenosillo  
 Fairbanks  
 Fang  
 OSFC  
 Gosan\_SBU  
 Gulistan  
 Heng-Chun  
 Henties\_Bay  
 ICEALOT  
 Jambi  
 KAUST\_Campus  
 Karpur  
 Kathelung  
 Kay\_Biscayne

#	Site	IS: 7SEAS Sites	Site Information	Active Periods
1	<a href="#">Bac_Lieu</a>		<a href="mailto:th.j.watson@nasa.gov">th.j.watson@nasa.gov</a> 730 Goddard Space Flight Center	
2	<a href="#">Bangiao</a>		<a href="mailto:g.ncu.edu.tw">g.ncu.edu.tw</a> 442 Goddard Space Flight Center	2017-07-16 to 2017-10-08
3	<a href="#">Doi_Ang_Khang</a>		<a href="mailto:s.baty-1@nasa.gov">s.baty-1@nasa.gov</a> 500	2013-02-01 to 2013-04-15 2014-02-28 to 2014-04-19 2015-03-15 to 2015-04-17
4	<a href="#">Doi_Inthanon</a>		<a href="mailto:trromodo@gmail.com">trromodo@gmail.com</a> 820 Astronomical Research Institute of Thailand	2018-10-25 to 2019-01-30
5	<a href="#">Doulu</a>		<a href="mailto:g.ncu.edu.tw">g.ncu.edu.tw</a> 545	2015-09-12 to 2015-10-28 2017-04-18 to 2017-10-03
6	<a href="#">EPA-NCU</a>		<a href="mailto:g.ncu.edu.tw">g.ncu.edu.tw</a> <a href="mailto:sohnyc@g.ncu.edu.tw">sohnyc@g.ncu.edu.tw</a> <a href="mailto:j.stefani.huang@g.ncu.edu.tw">j.stefani.huang@g.ncu.edu.tw</a> <a href="mailto:nync@g.ncu.edu.tw">nync@g.ncu.edu.tw</a> <a href="mailto:arfo@g.ncu.edu.tw">arfo@g.ncu.edu.tw</a> 181	2005-01-04 to 2010-05-13 2011-12-19 to current
7	<a href="#">Fang</a>		<a href="mailto:trromodo@gmail.com">trromodo@gmail.com</a> 320	2019-01-31 to 2019-09-17



# Overview of MPLNET: New Online Data Portal

The screenshot shows a web browser displaying the MPLNET Data Portal. The URL is `mpinet.gsfc.nasa.gov/out/data/V3/GSFC/Y2019/M09/D15/`. The page features a NASA logo and the text "National Aeronautics and Space Administration Goddard Space Flight Center" on the left. The main header includes "MPLNET The NASA Micro-Pulse Lidar Network" and the "Goddard SPACE FLIGHT CENTER" logo. A navigation menu on the left lists categories like Home, Data, Project, Publications, News, Links, and About Us. The main content area displays the title "MPLNET Data Portal: V3/GSFC/Y2019/M09/D15/" and a note: "use of downloaded files must follow our [data policy](#)". A red warning message states: "We are preparing the data sets, if please check back later if data are missing or contact MPLNET staff." Below this is a table of data files with columns for Name, Last Modified, and Size.

Name	Last Modified	Size
Parent Directory	-	-
<a href="#">MPLNET_V3_L1_AER_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:23	32M
<a href="#">MPLNET_V3_L1_CLD_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:12	21M
<a href="#">MPLNET_V3_L1_NPB_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:11	24M
<a href="#">MPLNET_V3_L1_PBL_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:27	2.5M
<a href="#">MPLNET_V3_L15_AER_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:41	32M
<a href="#">MPLNET_V3_L15_CLD_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:30	21M
<a href="#">MPLNET_V3_L15_NPB_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:29	24M
<a href="#">MPLNET_V3_L15_PBL_20190915_MPL44258_GSFC.nc4</a>	2019-09-22 23:43	2.5M

Easy to automate data grabs with `wget` or `curl`  
Setup for Data Center Interoperability (DCIO) applications

**Footer:** National Aeronautics and Space Administration Goddard Space Flight Center | Sciences and Exploration Directorate Earth Sciences Division Laboratory for Atmospheres Mesoscale Atmospheric Processes | NASA Official: Elsworth-Judd Nelson Webmaster: Elsworth-Judd Nelson Privacy Policy and Important Notice | Contact NASA Visit [NASA.gov](#) Contact MPLNET GSFC Homepage | Goddard SPACE FLIGHT CENTER

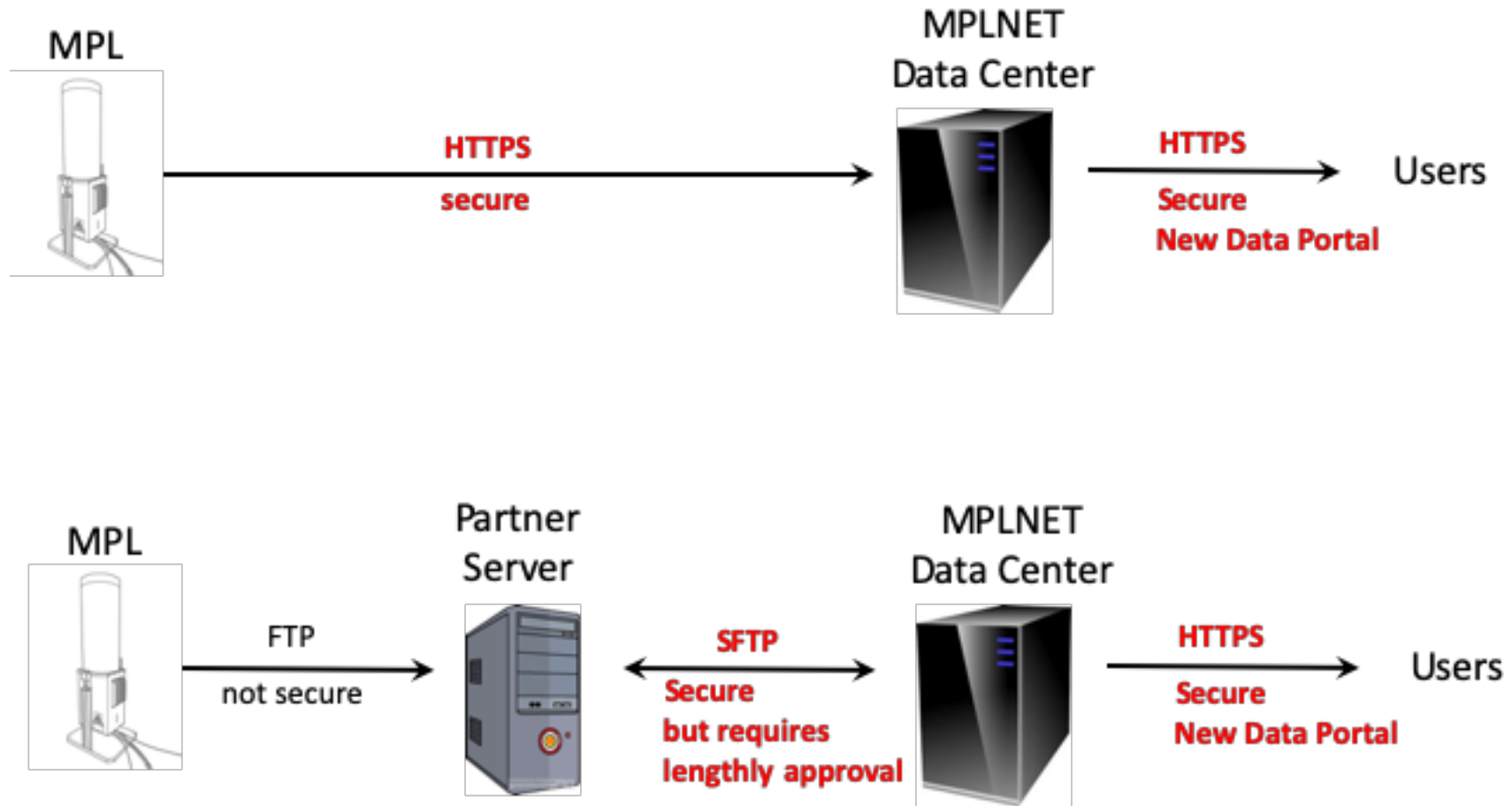




# MPLNET: Data Communications


Automated Push scripts  
on instruments

Automated Processing Hourly






# MPLNET Network Management: Site Status & Automated Alert System



## MPLNET

The NASA Micro-Pulse Lidar Network



**Active Site Status: 2019-09-30 13:02:16**

Problem ■    Alert ■    Good ■  
 missing overlap and polarization calcs temporarily ignored

#	Site	Instrument	L1 Data	DC Cal Data	AP Cal Data	Energy	Box Temp
8	GSEC	MPL44258		DC Data Overdue	AP Data Overdue		
9	Karsar	MPL44240	2019-09-20 13:00:00 10.0 days ago			energy deviation from set point > 20% Energy: 6.5 uJ set point: 5.0 uJ	no set point
10	KAUST_Campus	MPL44233	2019-07-30 15:00:00 61.9 days ago	DC Data Overdue	AP Data Overdue	Low Energy (< 2 uJ)	no set point
11	Klog_George_Island	MPL55036				no set point	no set point
12	Kuching	MPL44251					no set point
13	NASA_LaRC	MPL44104					
14	Process_Skindhorn_AstroPark	MPL55038	2019-09-29 06:00:00 1.3 days ago				no set point
15	Santa_Cruz_Tenerife	MPL44255					
16	SEDE_BOKER	MPL44241					no set point
17	Sigma_Space_Corp	MPL44111		DC Data Overdue	AP Data Overdue		
18	Slovakia_Univ	MPL44234		DC Data Overdue	AP Data Overdue		no set point
19	Singapore	MPL44235	2019-07-16 13:00:00 76.0 days ago	DC Data Overdue	AP Data Overdue	Low Energy (< 2 uJ)	temp NaN or INF

Note 1: click on the row number to see plots of the L1 NRFB, Volume Depolarization Ratio, and Instrument Diagnostics  
 Note 2: only the last minute of received data is used to determine instrument energy and box temp status, see diagnostic plots for past week statistics  
 Note 3: the table can be limited to specific site(s), example URL: <https://mplnet.gsfc.nasa.gov/operations/status?sites=sitenam1,sitenam2,sitenamN>

Home

Data

Product Information

Browse V3 Data

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Operations

Joining MPLNET

Publications

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# MPLNET Network Management: Processing Monitor

## MPLNET Processing Monitor:

Log: [mpl\\_auto\\_3](#) Auto Date: 2019-09-30 Auto Hour: Current View Log View active processes [Go to MPLNET Operations Page](#)

mpl_auto_1	mpl_auto_2	mpl_auto_3	mpl_auto_4	mpl_auto_5	mpl_auto_6	mpl_auto_7	mpl_auto_8	mpl_auto_9
10 mins after hour	10 mins after hour	10 mins after hour	10 mins after hour	10 mins after hour	10 mins after hour	10 mins after hour	10 mins after hour	10 mins after hour
Process Time: 00:36:27	Process Time: 00:19:50	Process Time: 00:34:27	Process Time: 00:02:48	Process Time: 00:01:45	Process Time: 00:03:24	Process Time: 00:32:37	Process Time: 00:51:04	Process Time: 00:03:58
Appalachian_State Barcelona Bidur	Cape_San_Juan El_Arenosillo EPA-NCU	Fairbanks GSFC KAUST_Campus	Kanpur King_George_Island Kuching	MPL44244-NCU MPL44250-NCU MPL44250-WFR0708-NCU	MPL44254-WFR0704-UMBC MPL44255-WFR0705-TEN MPL44258-WFR0706-LAB	NASA_LaRC Princess_Sirindhorn_AstroPark SEDE_BOKER	Santa_Cruz_Tenerife Sigma_Space_Coep Silpakorn_Univ	Singapore Songkhla_Regional_Observatory South_Pole UMBC Xi'an

Saved V3\_staff download file: MPLNET\_V3\_L1\_CLD\_20190927\_MPL44258\_GSFC.nc4  
 Saved V3\_partners download file: MPLNET\_V3\_L1\_CLD\_20190927\_MPL44258\_GSFC.nc4  
 % Time elapsed: 52.171768 seconds.  
 Processing L1\_CLD for GSFC on 2019-09-28.  
 Saved archive file: MPLNET\_V3\_L1\_CLD\_20190928\_MPL44258\_GSFC.nc4  
 /MPLNET/download/V3/GSFC/  
 /MPLNET/download/V3\_staff/GSFC/  
 /MPLNET/download/V3\_partners/GSFC/  
 /MPLNET/download/nrt/GSFC/  
 rmdir: failed to remove /MPLNET/download/nrt/GSFC/download/nrt/GSFC: No such file or directory  
 rmdir: failed to remove /MPLNET/download/nrt/GSFC/download/nrt: No such file or directory  
 rmdir: failed to remove /MPLNET/download/nrt/GSFC/download: No such file or directory  
 Saved V3 download file: MPLNET\_V3\_L1\_CLD\_20190928\_MPL44258\_GSFC.nc4  
 Saved V3\_staff download file: MPLNET\_V3\_L1\_CLD\_20190928\_MPL44258\_GSFC.nc4  
 Saved V3\_partners download file: MPLNET\_V3\_L1\_CLD\_20190928\_MPL44258\_GSFC.nc4  
 Saved NRT download file: MPLNET\_V3\_L1\_CLD\_20190928\_MPL44258\_GSFC.nc4  
 % Time elapsed: 40.333944 seconds.  
 Processing L1\_CLD for GSFC on 2019-09-29.  
 Saved archive file: MPLNET\_V3\_L1\_CLD\_20190929\_MPL44258\_GSFC.nc4  
 /MPLNET/download/V3/GSFC/  
 /MPLNET/download/V3\_staff/GSFC/  
 /MPLNET/download/V3\_partners/GSFC/  
 /MPLNET/download/nrt/GSFC/  
 rmdir: failed to remove /MPLNET/download/nrt/GSFC/download/nrt/GSFC: No such file or directory  
 rmdir: failed to remove /MPLNET/download/nrt/GSFC/download/nrt: No such file or directory  
 rmdir: failed to remove /MPLNET/download/nrt/GSFC/download: No such file or directory  
 Saved V3 download file: MPLNET\_V3\_L1\_CLD\_20190929\_MPL44258\_GSFC.nc4  
 Saved V3\_staff download file: MPLNET\_V3\_L1\_CLD\_20190929\_MPL44258\_GSFC.nc4  
 Saved V3\_partners download file: MPLNET\_V3\_L1\_CLD\_20190929\_MPL44258\_GSFC.nc4  
 Saved NRT download file: MPLNET\_V3\_L1\_CLD\_20190929\_MPL44258\_GSFC.nc4  
 % Time elapsed: 44.623764 seconds.  
 Processing L1\_CLD for GSFC on 2019-09-30.



Fact of life for long running projects:  
when a new Version is released its already out of date

MPLNET is developing new V4 products, testing in V3

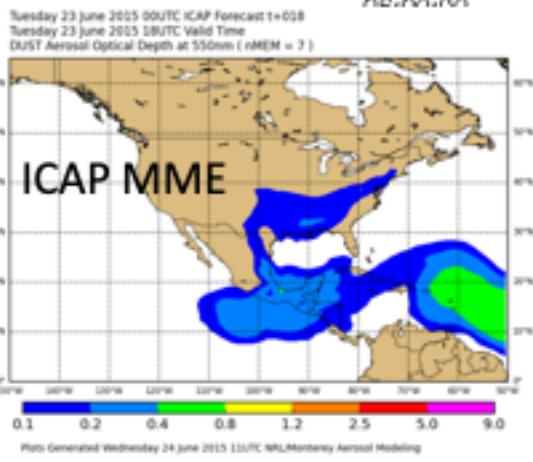
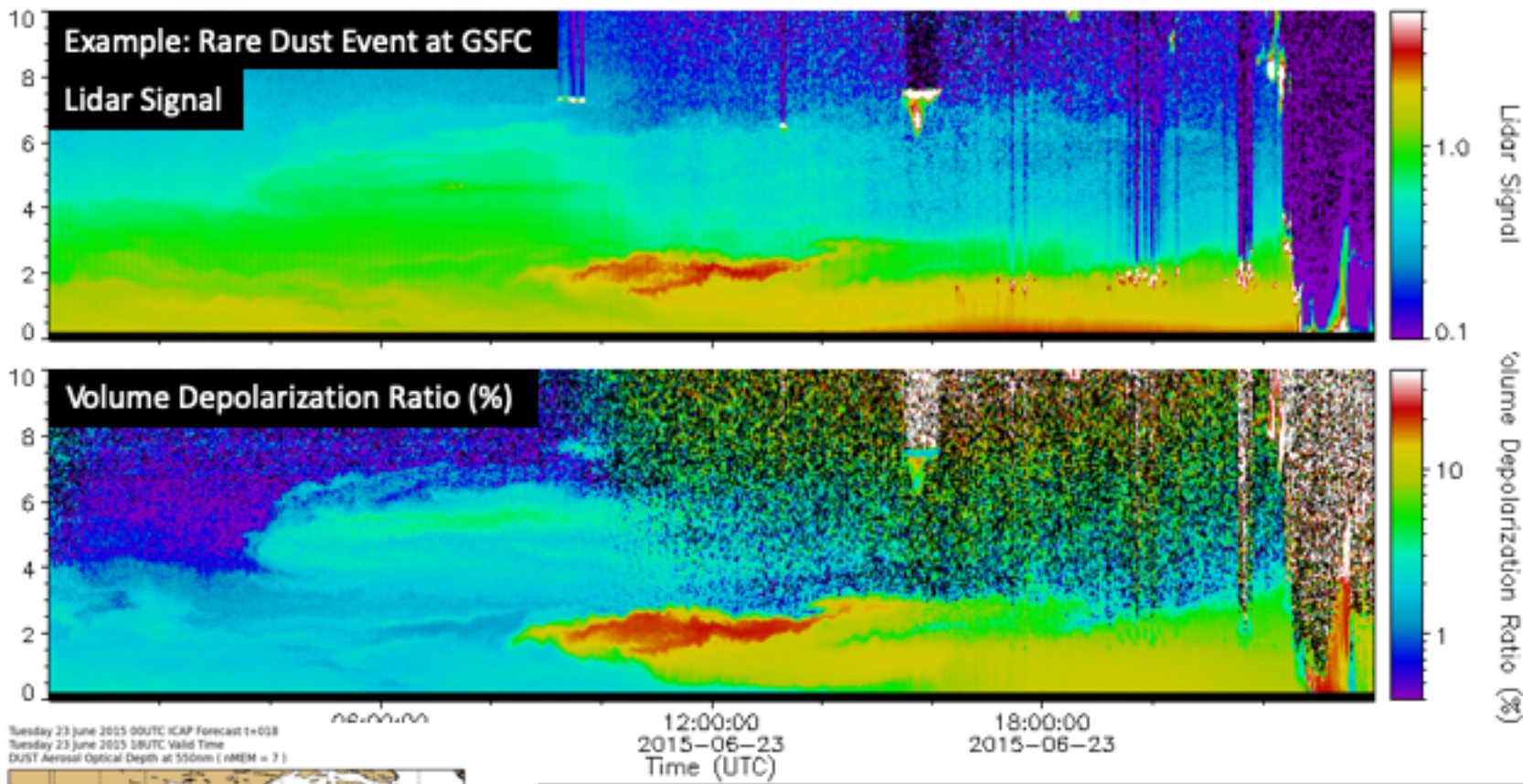
- Precipitation Product (see Lolli et al later this session)
- A NRT attenuated backscatter product
  - New aerosol & cloud detection algorithms
- Dust Alert System

Balancing R&D enhancements and network operations  
has been challenging with fixed budgets

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# MPLNET Support for operational aerosol forecasting: dust detection



## International Cooperative for Aerosol Prediction (ICAP)

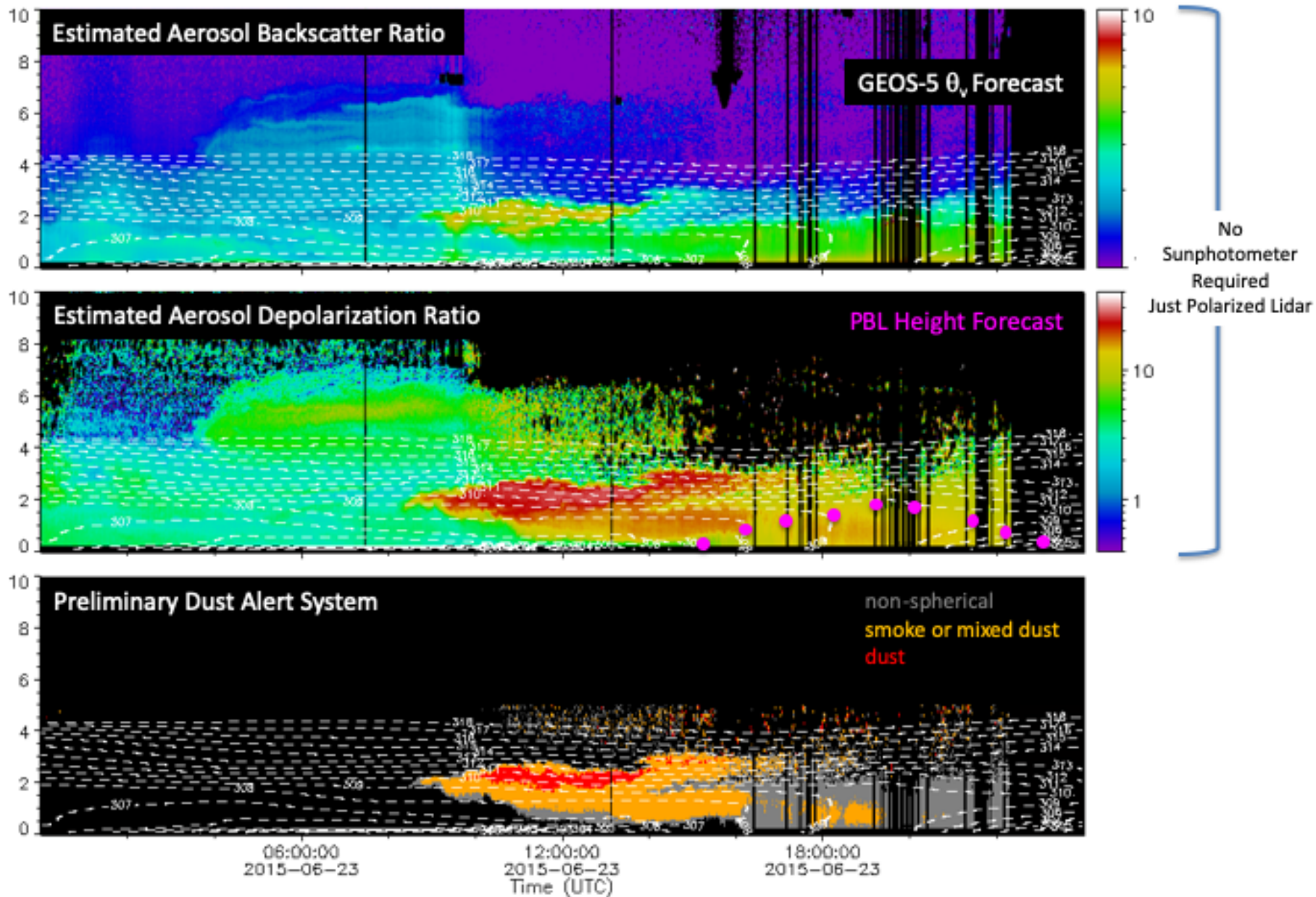
- Members from operational forecast centers worldwide & data providers
- Developed Research Multi-model Ensemble (MME) forecasting speciated AOD

## Dust detection, alert system

- Local air quality assessment
- Aerosol forecasting (ICAP members)
  - Includes WMO Sand & Dust Storm Warning & Advisory System (SDS-WAS)
  - Model verification (NRT and historical)
  - Eventual assimilation
- Research support (catalog dust occurrences)



# MPLNET Support for operational aerosol forecasting: dust detection





## Conclusion

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GALION networks and related ceilometer and lidar networks have grown drastically this century

- Global coverage has increased correspondingly, more data available

However, ground lidar data is now dispersed over many different data centers

- also, products, file formats, NRT capability, etc all vary
- more complicated process for users to discover & access all this new data

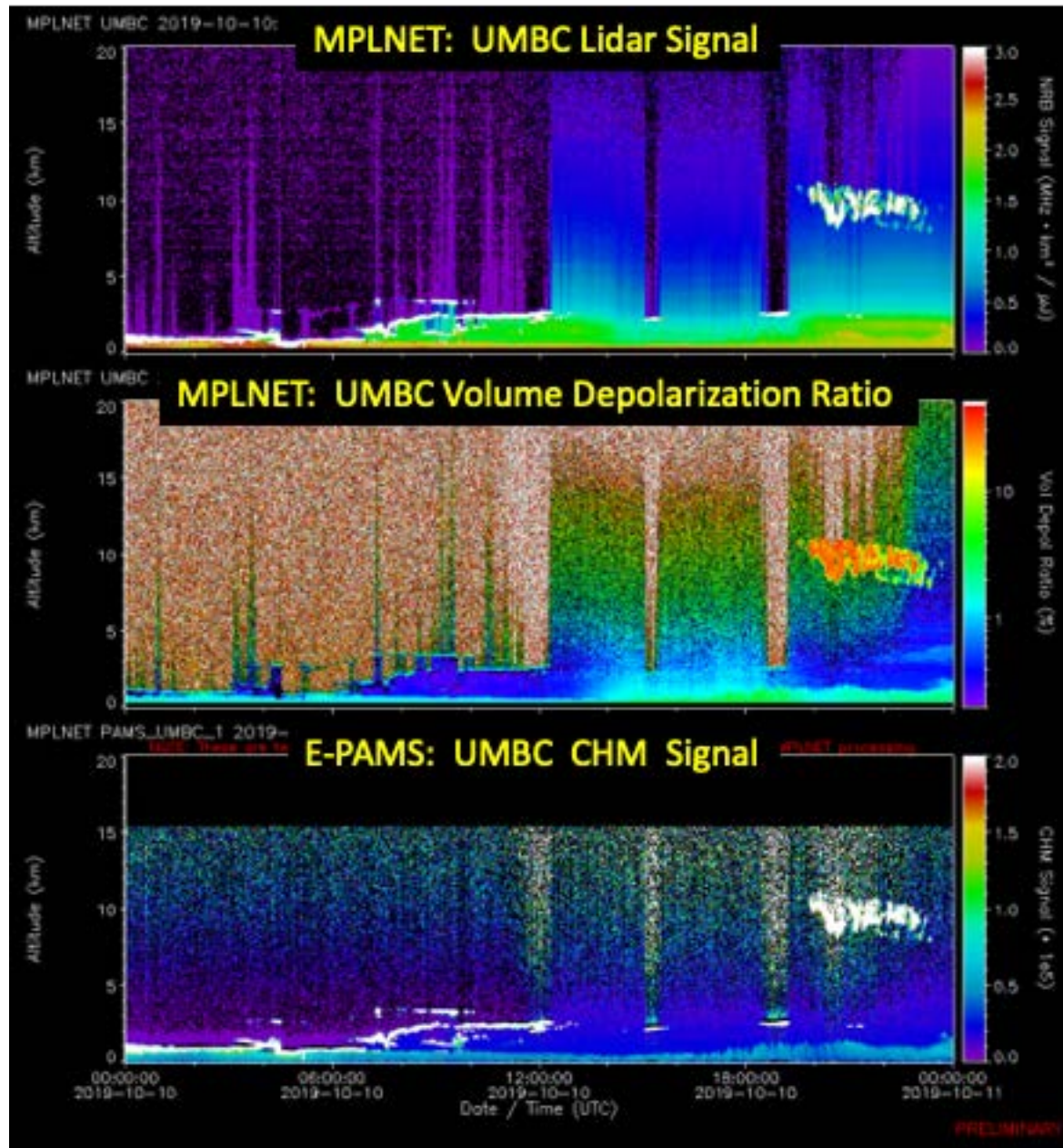
GALION Goal: create a world data center for lidar network data

- Distributed approach utilizing existing network level data centers
  - Provide common metadata archive for search & discovery
  - eventually common data products & file download
- MPLNET is planning to build a US GALION data center node
  - can support lidars outside MPLNET





# MPLNET & UMBC: E-PAMS Collaboration







## Conclusion

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NA Contribution to GALION could grow with addition of new networks

- I propose creation of a NA lidar network working group
    - Gather information on each network
    - develop plans to fill coverage gaps
    - teams for processing/calibration standards
    - Consider a common, distributed data center ala GALION
    - Provide career pathways for students
-