DiscAQ UMBC ground lidar data status and future plans

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February 14, 2012
DISCOVER-AQ Workshop

UMBC generated results currently in the NASA archive (as of Feb 14, 2012)

Name	Location	Operation	Key Parameters	Format	Version	Status/Notes
ALS450	Ground_UMBC	Continuous, 1 min. every ½ hr	355 nm Backscatter and Extinction profiles	H5	R1	No corrections expected. Scanning data not analyzed
BAM	Ground_UMBC	Continuous, 1 hr resolution	Surface PM2.5	ICT	R0	No corrections expected.
ELF	Ground_UMBC	Flight days	532 nm Backscatter and Extinction profiles, "PBL" heights	H5	R2	
Neph	Ground_UMBC	Continuous, 15 min resolution	Surface scattering coef(450, 550, 700 nm) Surface backscattering coef.(450, 500, 700nm)	ICT	RB?	No corrections expected
TEOM	Ground_UMBC	Continuous 15 min(noisy) 1 hr (better)	Surface PM2.5	ICT	R1	No corrections expected. Do not use data after July 21 because of overload of filter.
MPL	Multiple	Continuous, 1 min	532 nm Atten. Backscatter profiles, "PBL" heights	H5	R1	Additional corrections expected. Version R2 anticipated with additional data products

Lots and lots of ground lidars ...

- UMBC ELF lidar (532 nm)
- UMBC Alex lidar (355 nm)
- UMBC-MPL (527 nm), GSFC-MPL (527 nm) both participating in NASA's MPLNET project
- Millersville MPL (532 nm?)
- Leosphere Wind lidar @ Edgewood (1.5μm)
- Cimel CAML traveling “car” lidar (532 nm)
- Howard UV Raman system
- Vaisala Ceilometers (near-IR)
- Four MPLs loaned by Sigma Space (532 nm)
  - 1 “standard MPL”: Fairhill
  - 3 “mini MPLs”: Edgewood, Essex, Ship, Beltsville

Focus for this talk

Sigma Space MPLs

Photo credit: Sigma Space

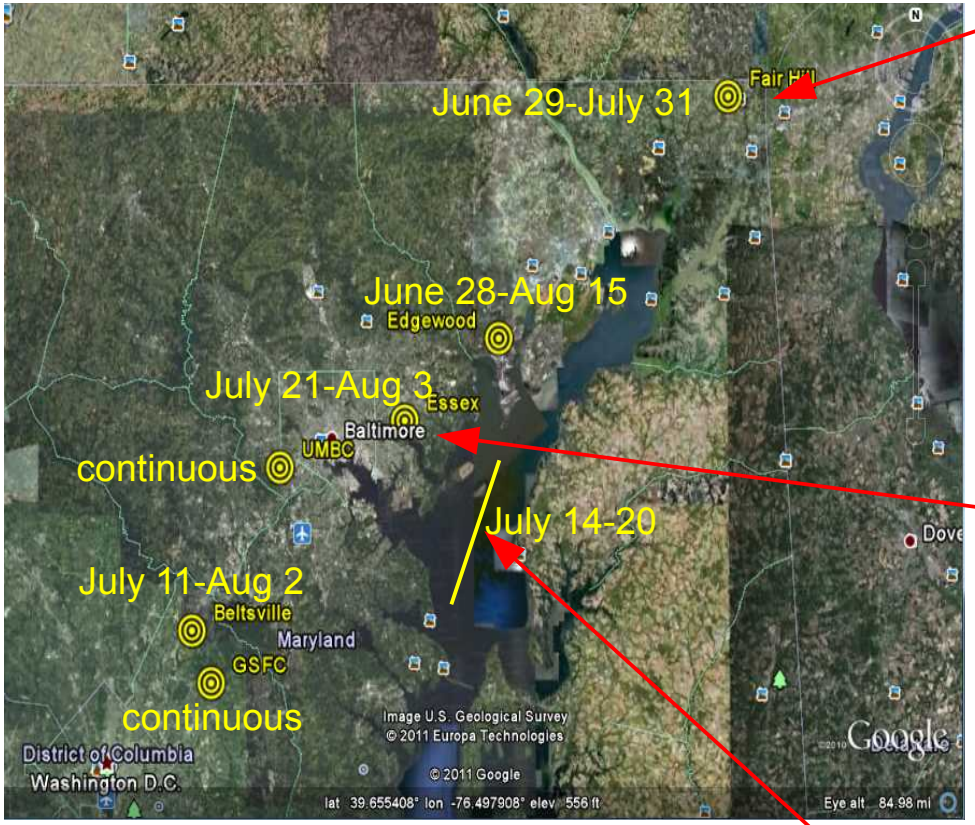
http://www.sigmaspace.com/index.php/products/mpl

Four lidars loaned at no cost by Sigma Space
(1 "Regular" and 3 "MiniMPLs")

Single wavelength 532 nm
"Eye-safe" Class II output
Depolarization capabilities

DiscAQ was UMBC's first experience with using the "MiniMPL" model for atmospheric monitoring

MPL Sites During DISCOVER AQ



Fairhill

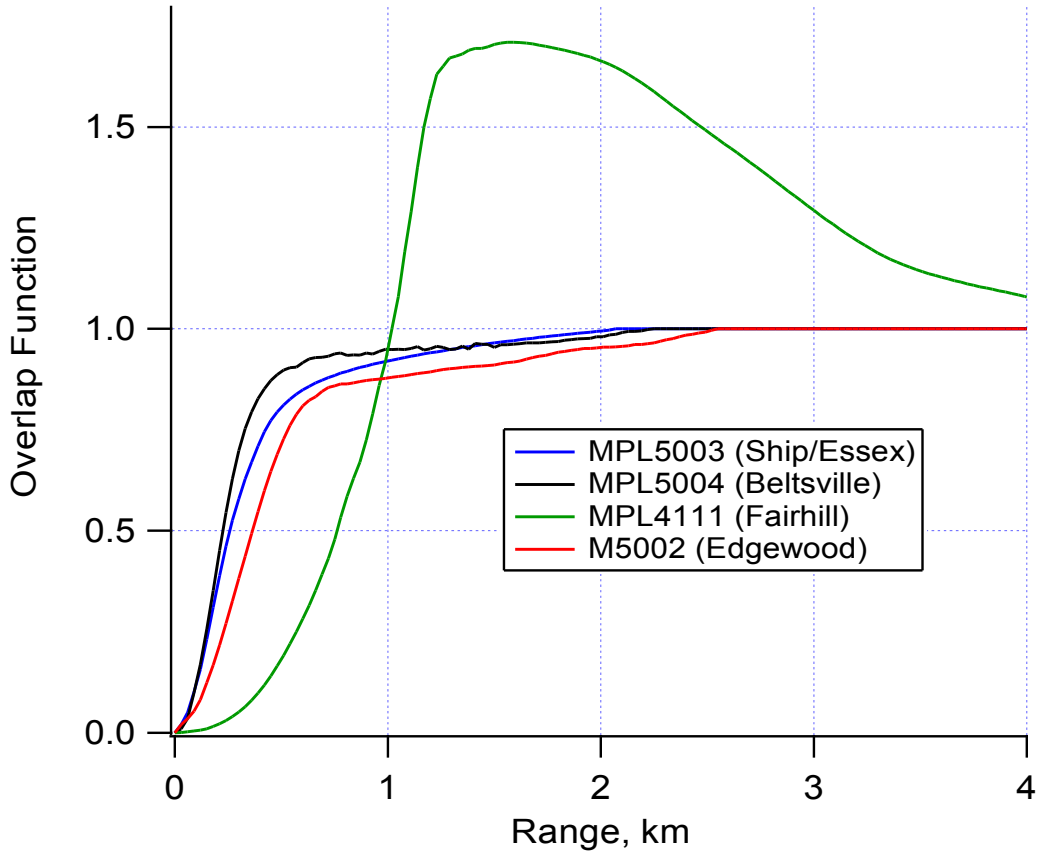
Essex

NOAA ship

All July: Edgewood, Fairhill, UMBC, GSFC
Part July: Beltsville (July 11 to Aug 2),
Ship (July 14 to20)
Essex (July 21 to Aug 3)

MPLNET sites

The near-range calibration challenge

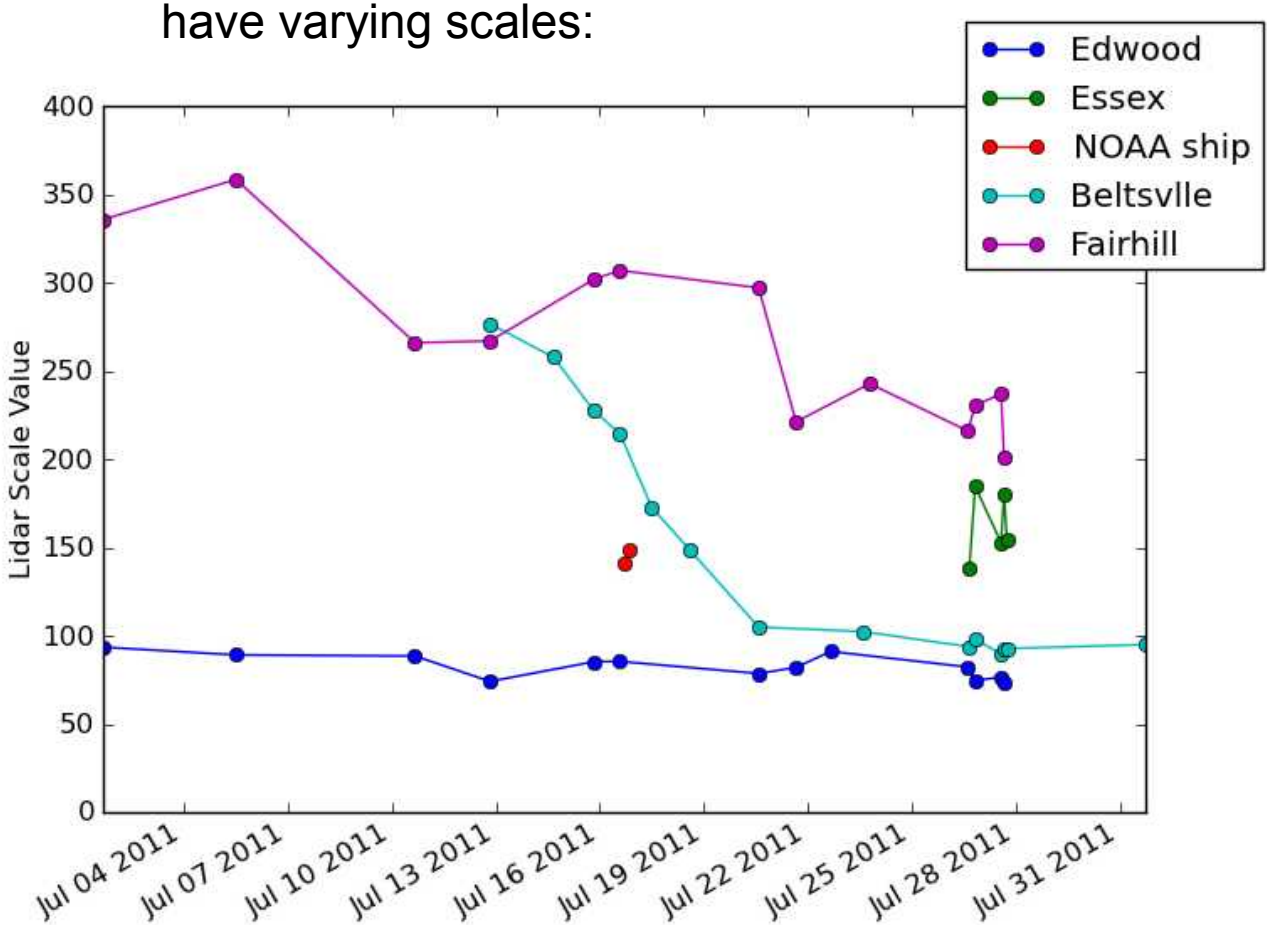


- Overlaps determined from co-located measurements at UMBC
- Fairhill overlap appears to be unstable and still has shape error in the near-field, will need to be studied further and updated

Post-campaign lidar calibration effort

- Rayleigh model, mid-latitude summer combined with co-located AERONET level 2 AOD to determine scale from particle-free region of the profiles
- Includes window transmission changes
- Wide range of scale factors, some varied significantly during campaign
- R1 H5 archive data have interp/fit to correct for scale changes. Daily/“real-time” quicklooks generated during July 2011 do not have these corrections applied

The reason why “real-time” campaign quicklooks have varying scales:



Attenuated backscatter Profiles in the archive

"R1" Currently in the archive:

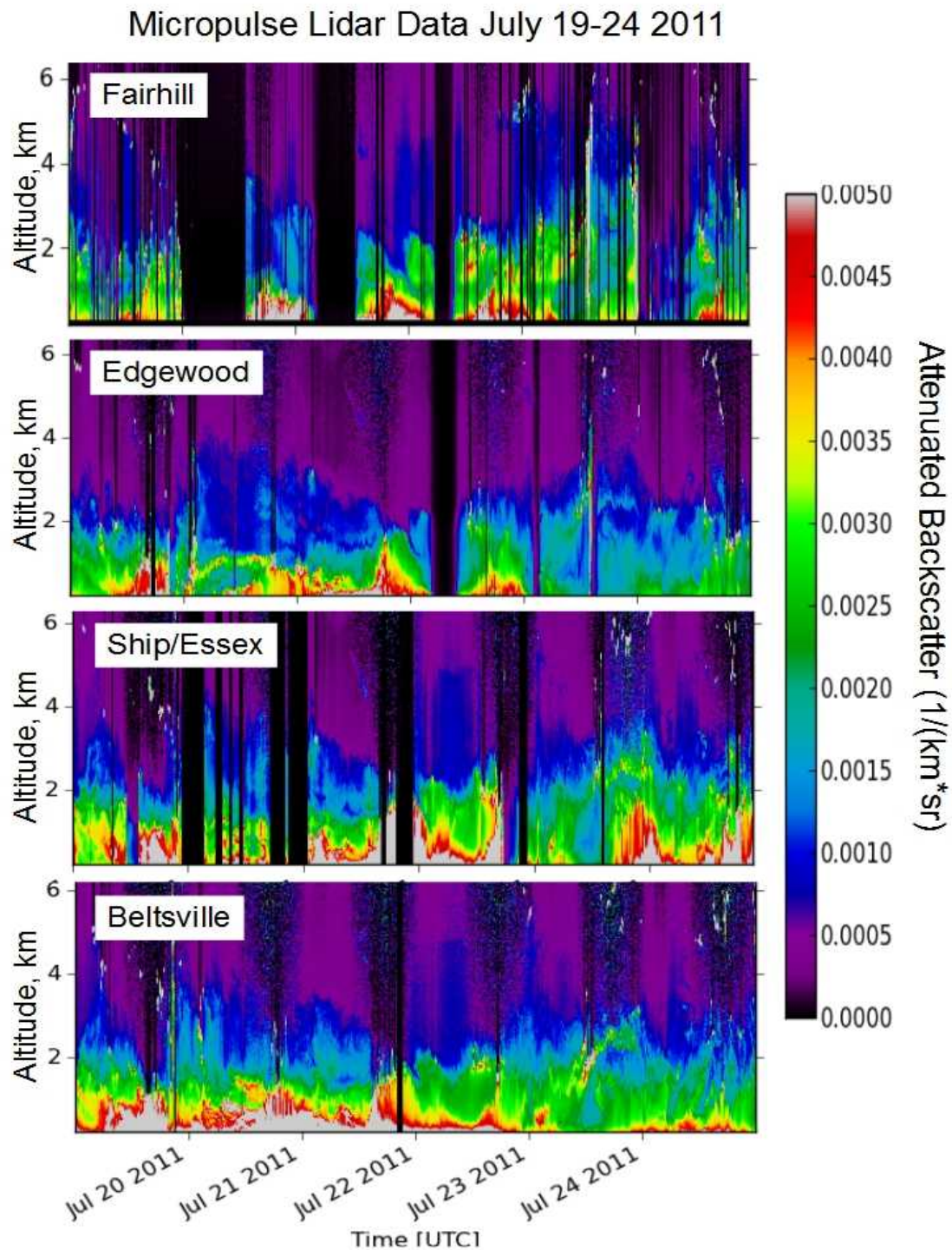
Attenuated Backscatter:

$AB = \beta(r)*T^2(r)$

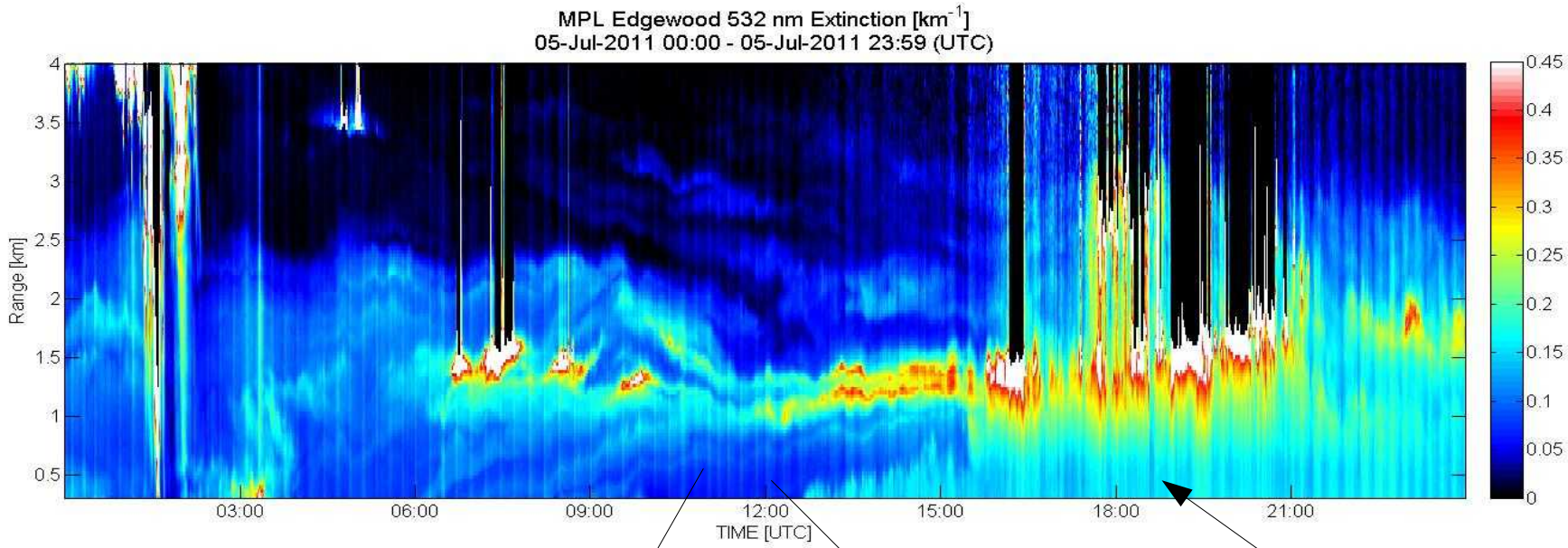
Inversion method is necessary to obtain $\beta(r)$, extinction, S-ratio that can be related to airborne HSRL data products

See Sawamura et. al. poster, for ELF inversion examples compared to HSRL

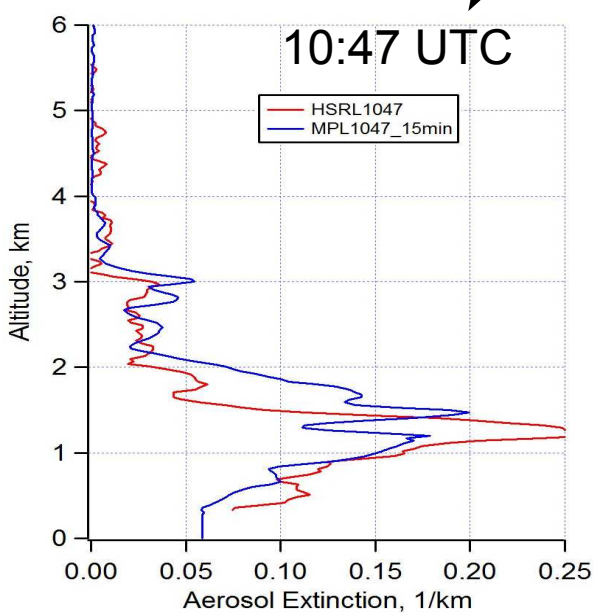
UMBC is currently working on applying same inversion code used for ELF to MPLs

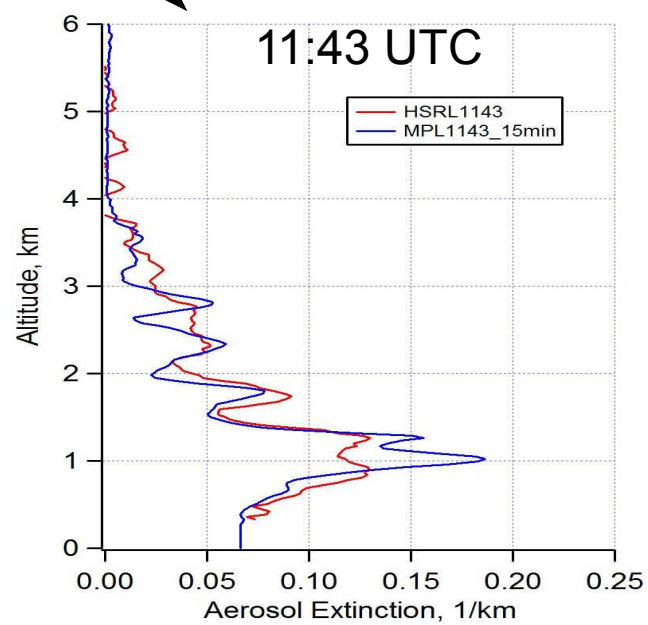


Aerosol Extinction Retrieval for July 5 Edgewood “MiniMPL”



Example Aerosol Extinction Comparisons with LARC Airborne HSRL

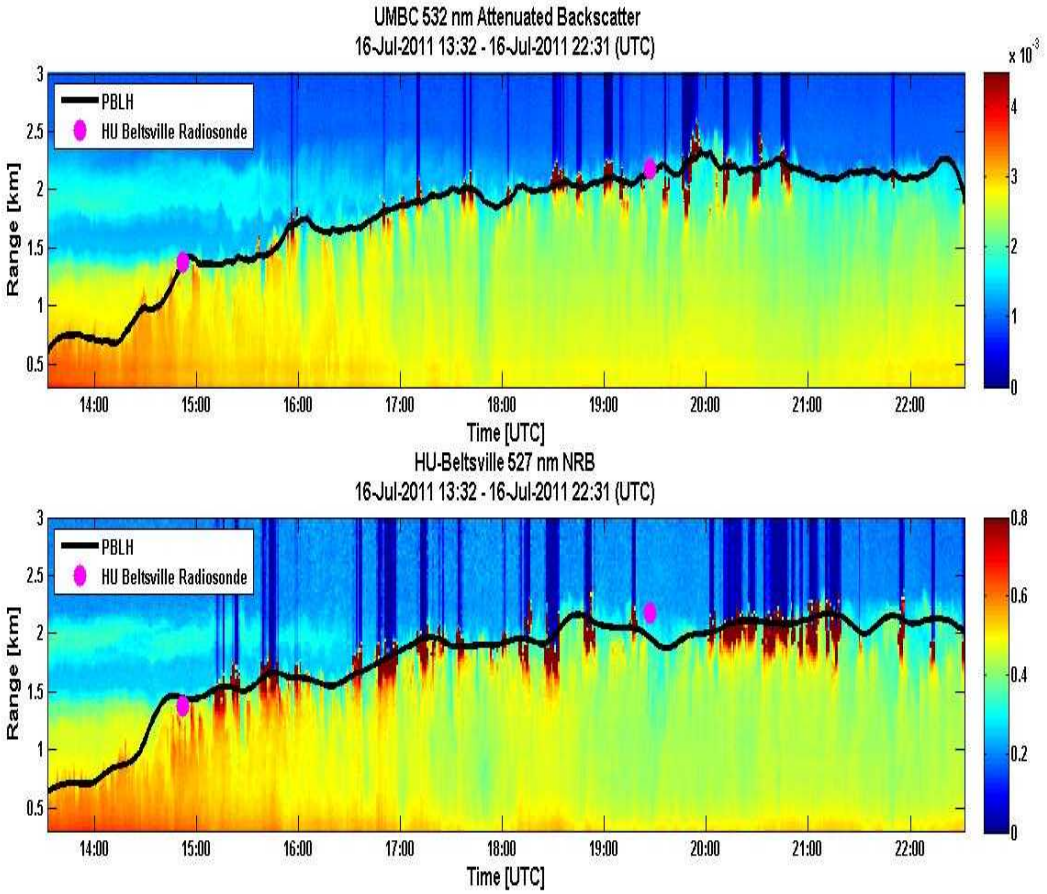




Enhanced Aerosol? See Tom Eck's Poster Enhanced AOD near cumulus

“PBL” heights in archive

- “PBL” in H5 R1 archive files with profile data
- Heights determined from wavelet analysis algorithm by Jamie Compton (UMBC), aerosol gradient
- Daytime tends to correspond PBL, nighttime heights are not likely representation of PBL
- Expect new PBL version to be available in 1-2 weeks
- See presentation later by Ruben Delgado and poster by Jamie Compton



No data set is perfect….

Data system dropouts (Fairhill, Essex and Ship data), data files have uneven time stamps

Range limit: Mini MPLs noisier than standard MPLs, daytime thin cirrus will be missed, data recorded only to 15 km,.

Mini-MPL data-set has B-subtract in 14-15 km range, potential errors >12 km

Morning dew formation or precip. on windows on some days

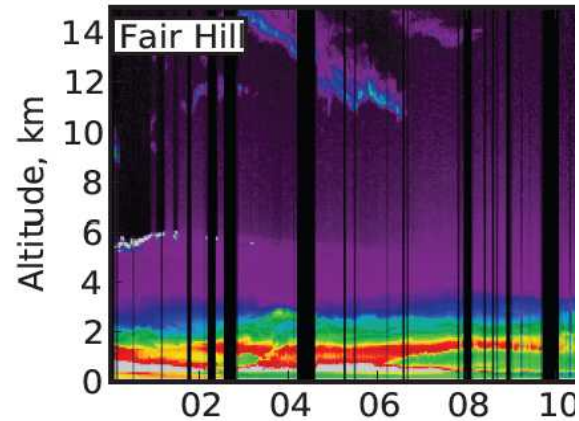
Overlap: Fairhill appears to be unstable, error in near field “dip” in signal

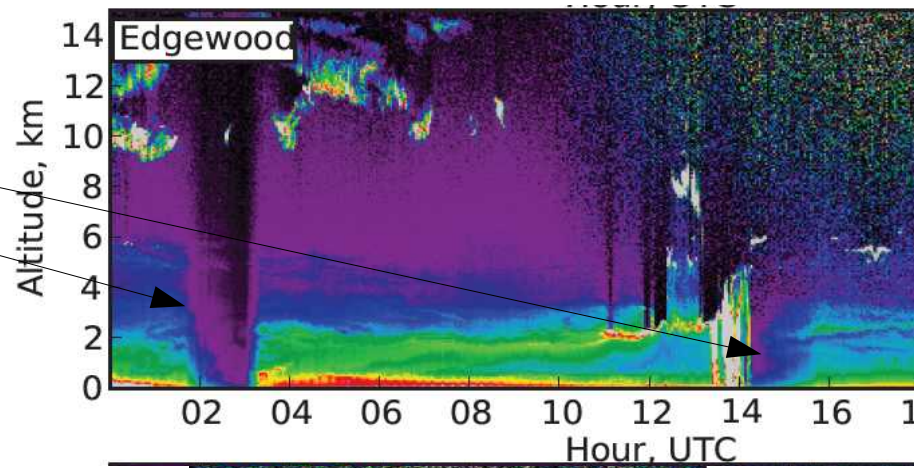
Arbitrary intensity changes (Essex, Ship)

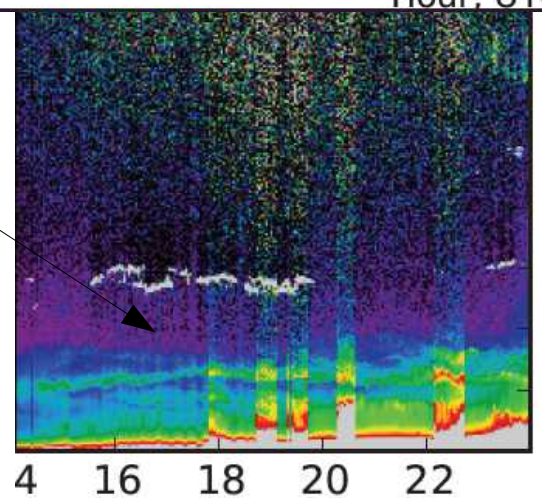
Bottom 0-300 m screened from archive

Overheating (Essex and Ship)

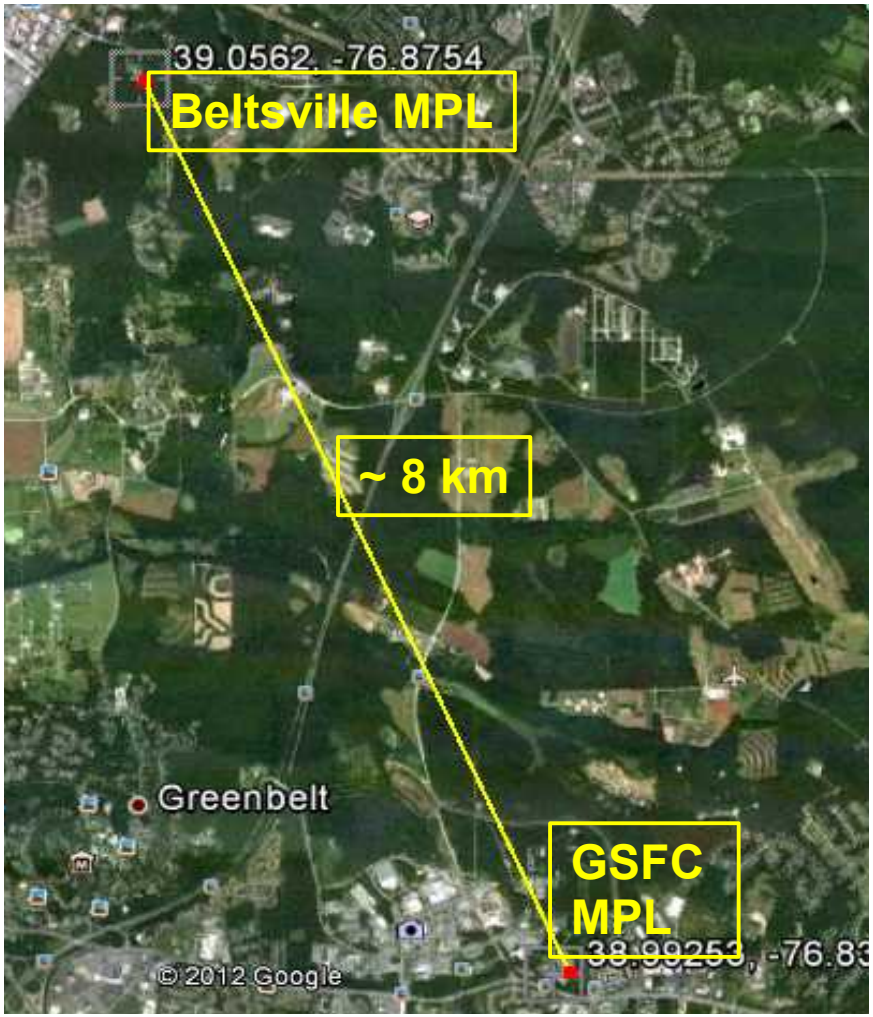
PLEASE contact UMBC when using MPL data, especially important when relying on quantitative profile values





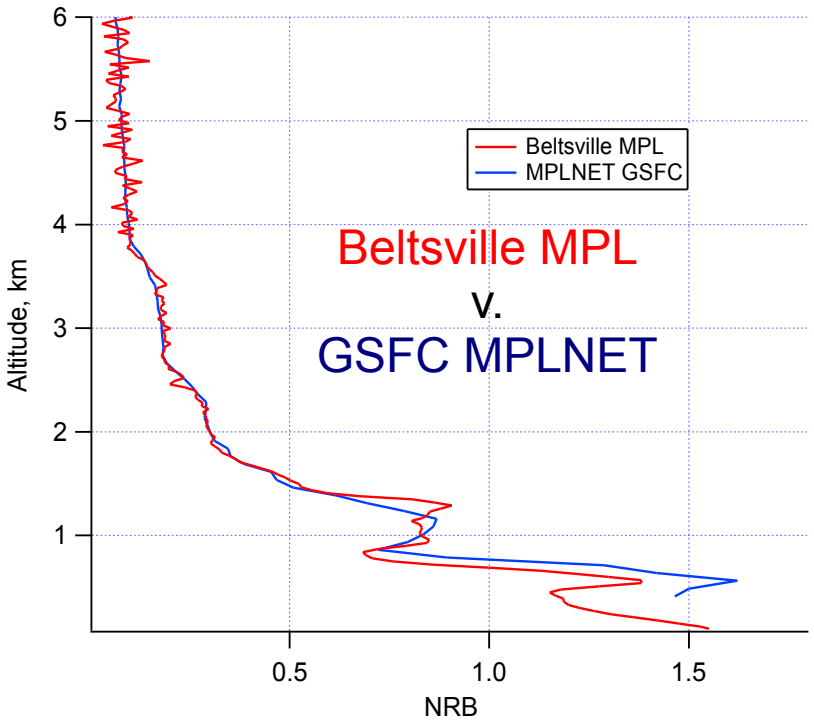


Cross-validation with MPLNET/GSFC data



July 20 Example

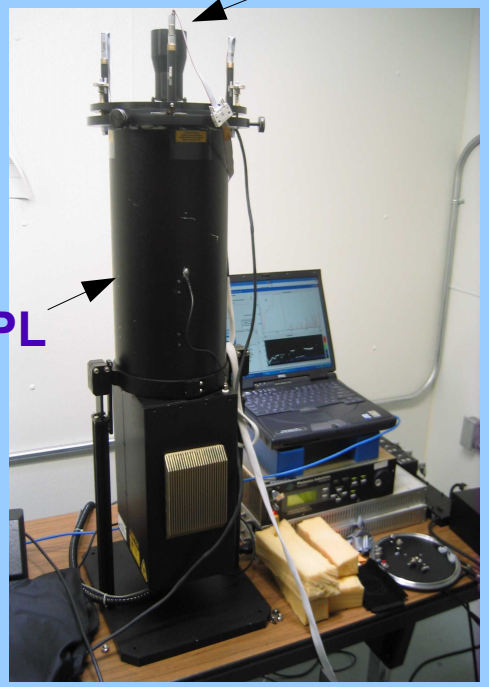
Profile comparison
14:00 to 14:30 UTC



What would be important for California?
MPL system w/WFOV

WFOV receiver

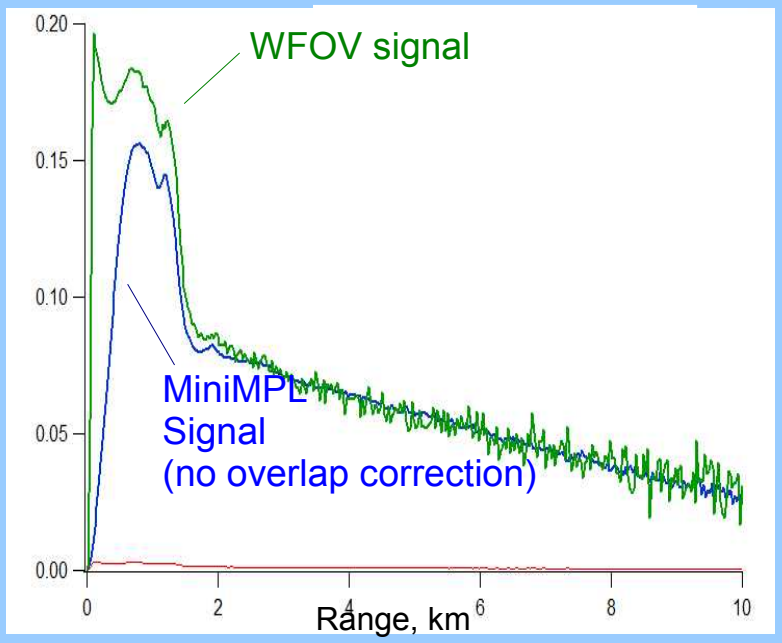
MPL



Side View

Top View

Example profile comparison between MiniMPL and WFOV receiver



The WVOF more easily eliminates the near-range overlap calibration problem and could be deployed into the field for DiscAQ 2013

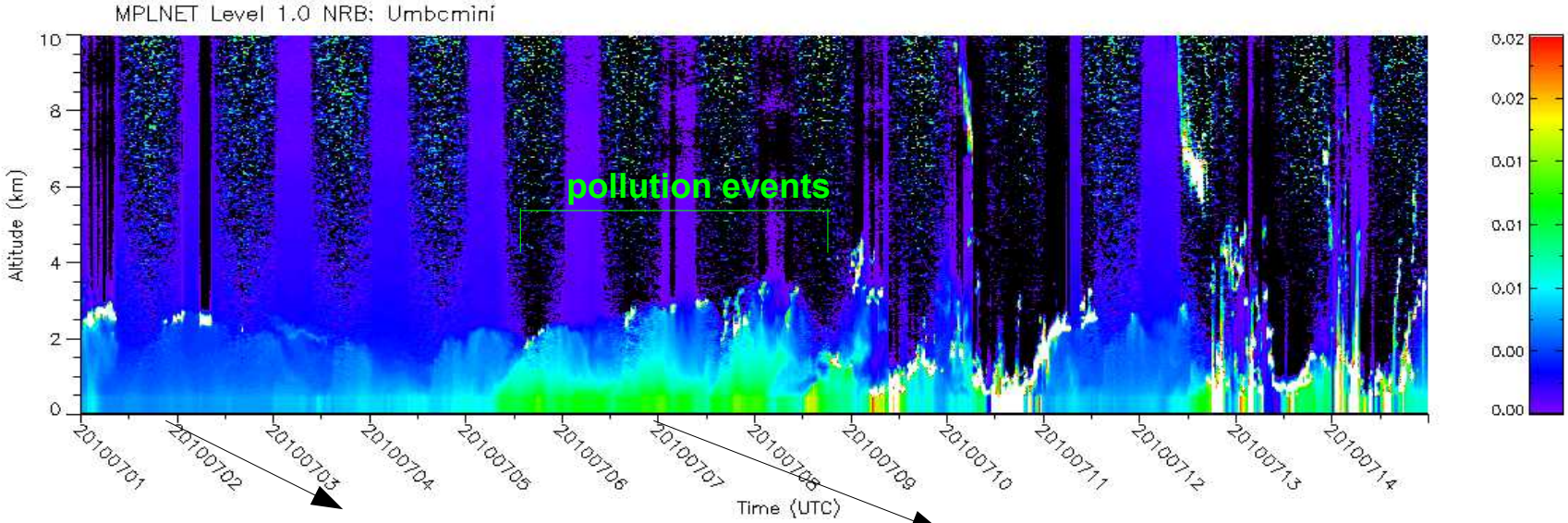
WFOV receiver measurement during July 2010 air quality event @ Baltimore

Multiple “Code Orange” AQI events

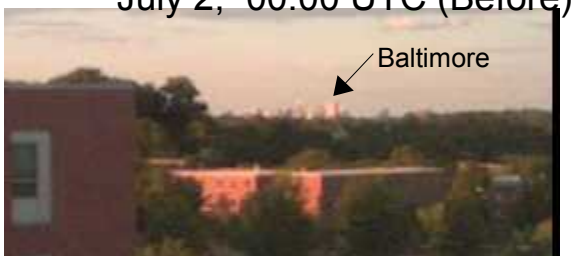
July 5
PM2.5
AQI

Airnow map

July 1 to July 14, 2010, “mini” NRB lidar image (30 m vert., 30 min. temporal resolution)



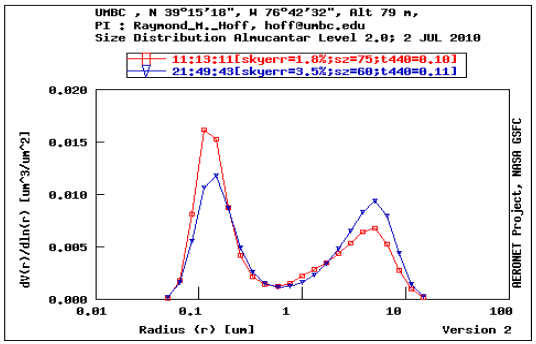
July 2, 00:00 UTC (Before)

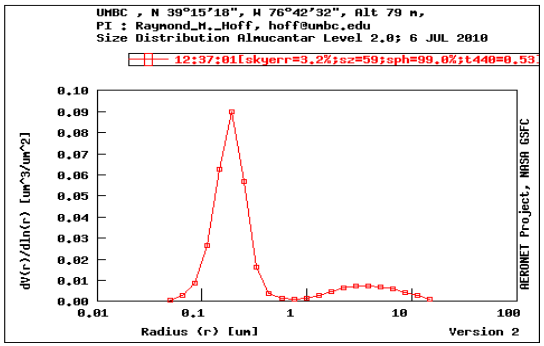


July 7, 00:00 UTC (during)

View of Baltimore
From UMBC

AERONET
Size distribution





Summary

UMBC surface data complete in final form

More/upgraded lidar data products to arrive in the future

Recommend MPL with WFOV receiver for California

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Open Source Software Credits: Python Programming Language Enthought Python Distribution (Data Processing), Open Office Productivity Suite (Presentation)

Data Source Credits : LARC-HSRL (Chris Hostetler, Rich Ferrare), MPLNET (Judd Welton), AERONET (Brent Holben), EPA/Airnow

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