



ARM

CLIMATE RESEARCH FACILITY

High Spectral Resolution LIDAR

ASR Aerosol Lifecycle Working Group
Optical Properties of Aerosols
Connor J. Flynn, Sept 12, 2011

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Albert Mendoza: PNNL



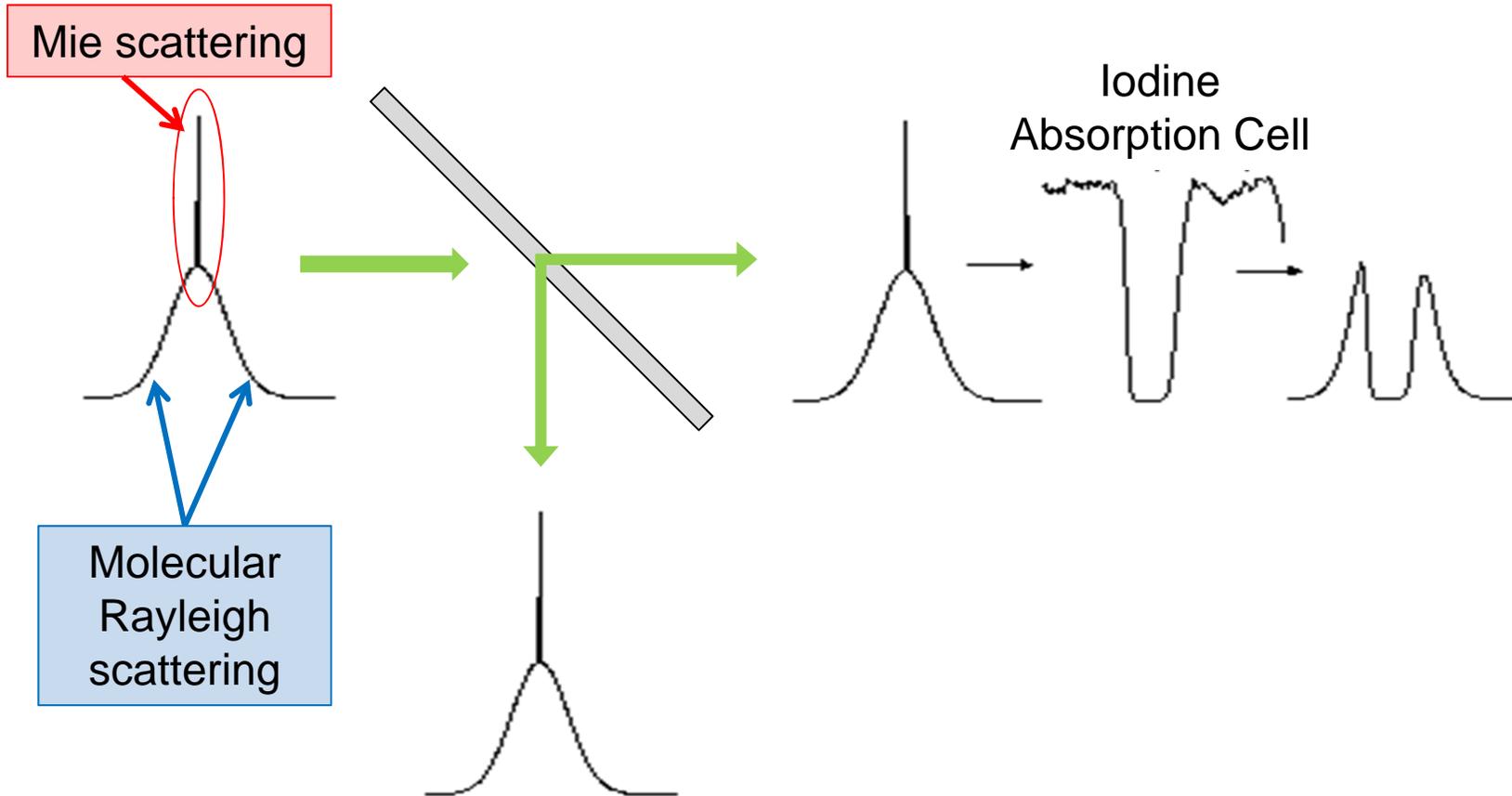
U.S. DEPARTMENT OF
ENERGY

Office of
Science

What is High-Spectral Resolution LIDAR?

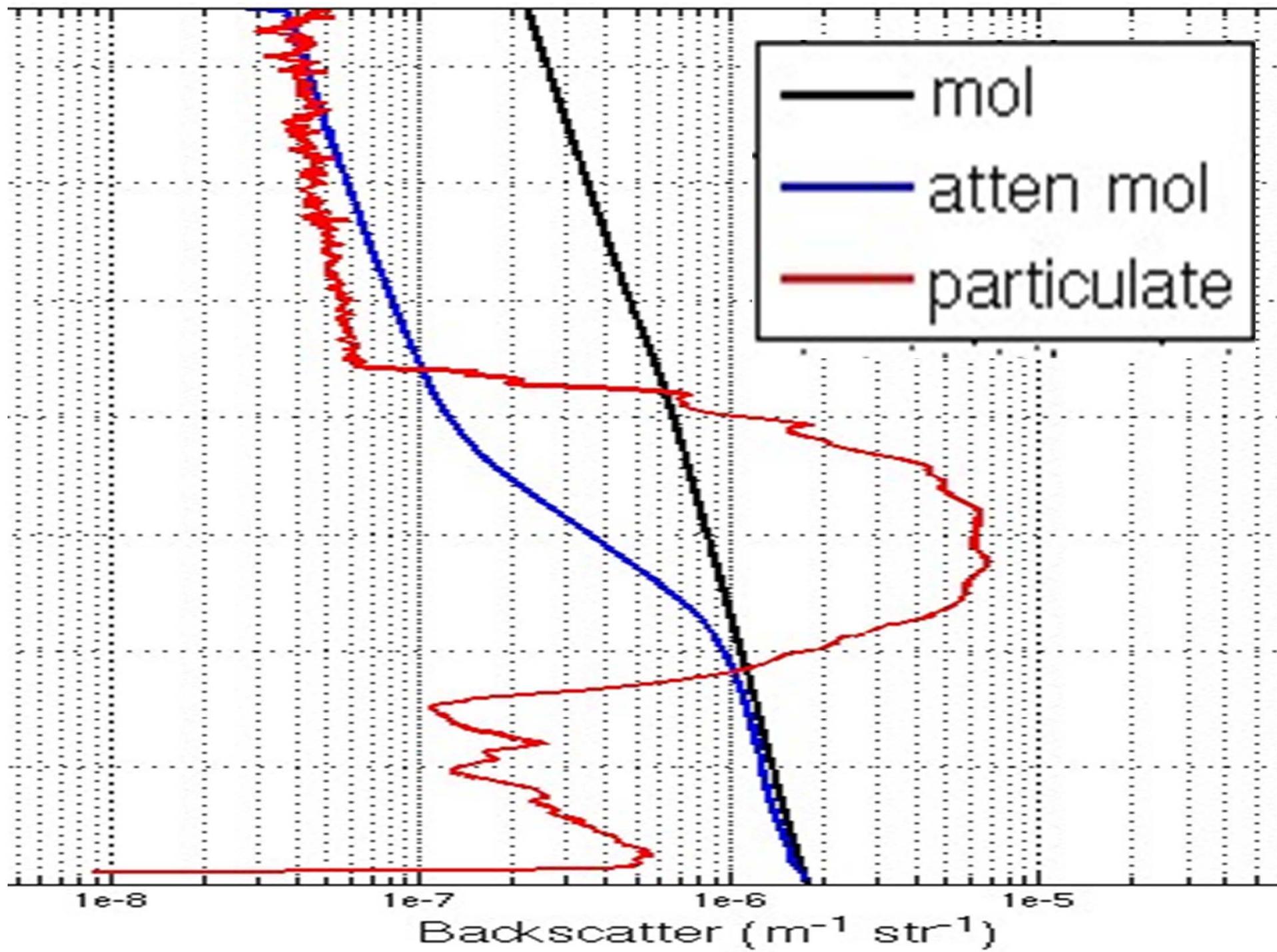
- Elastically backscattered light from the atmosphere shows some spectral features
 - Molecular return exhibits larger Doppler broadening
 - Slower moving particles yield less broadening.
- High-Spectral Resolution Lidar (HSRL) systems employ very high resolution optical detection to distinguish the sharper particulate return from the broader molecular return.

Separation of Mie and Rayleigh



Okay, so we know what it is but why do this?

- Separately identifying molecular and particulate elastic scattering permits independent determination of particulate backscatter and extinction.
- While Raman Lidar requires high power to overcome weak Raman scattering cross sections, HSRL elastic signal is strong but requires fine control of laser and detection.



ARM has two HSRL systems

- Through recovery act funds, ARM has purchased and deployed two HSRL systems.
- Designed and built at SSEC, Madison WI
- Provides:
 - Particulate Backscatter Cross Section
 - Particulate Extinction Cross Section
 - Particulate Extinction to Backscatter Ratio
 - Particulate Depolarization

And more ...



ARM HSRL Systems: MF2HSRL and NSAHSRL

MF2HSRL

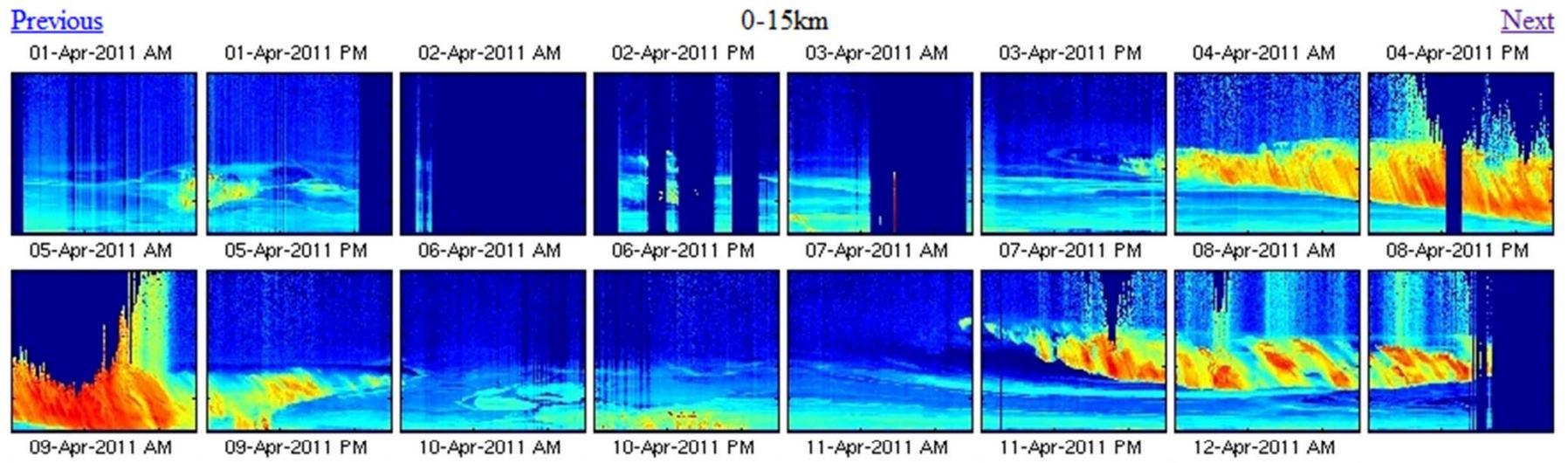
- 1st deployed with AMF2 Thunderhead site for StormVex.
 - Jan 20 – Apr 25, 2011
 - High up-time.
- Next deployment imminent to Gan Island, in Maldives

NSAHSRL

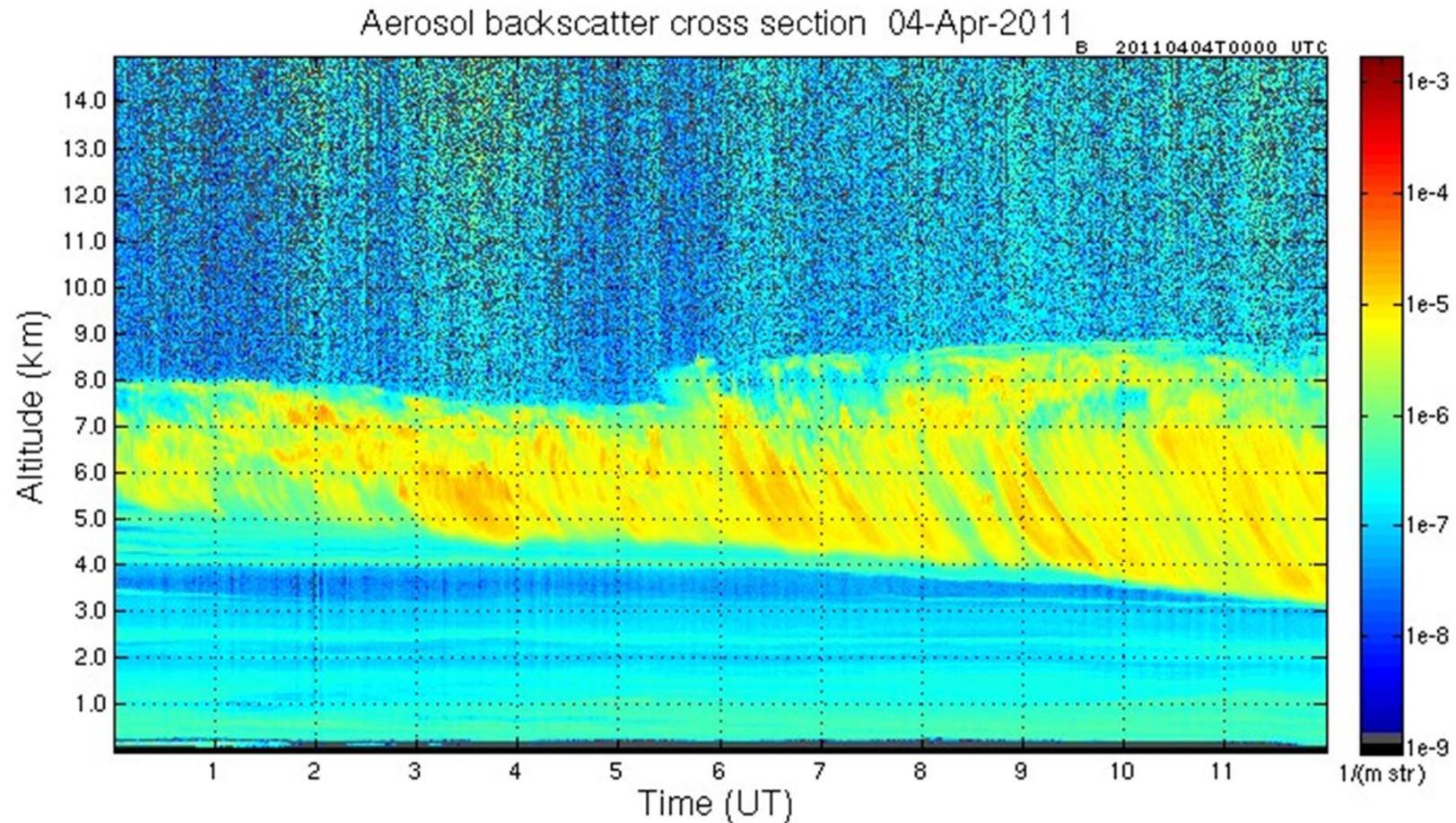
- Installed March 20, 2011
- Shelter over heat incident, April 11
- Adversely impacted
- Not currently optimal
- Firm path forward to repair in hand

In addition to LIDAR HW, also comes with impressive SW

- Monthly collections of Quick Look thumbnails of backscatter, depolarization, or combined

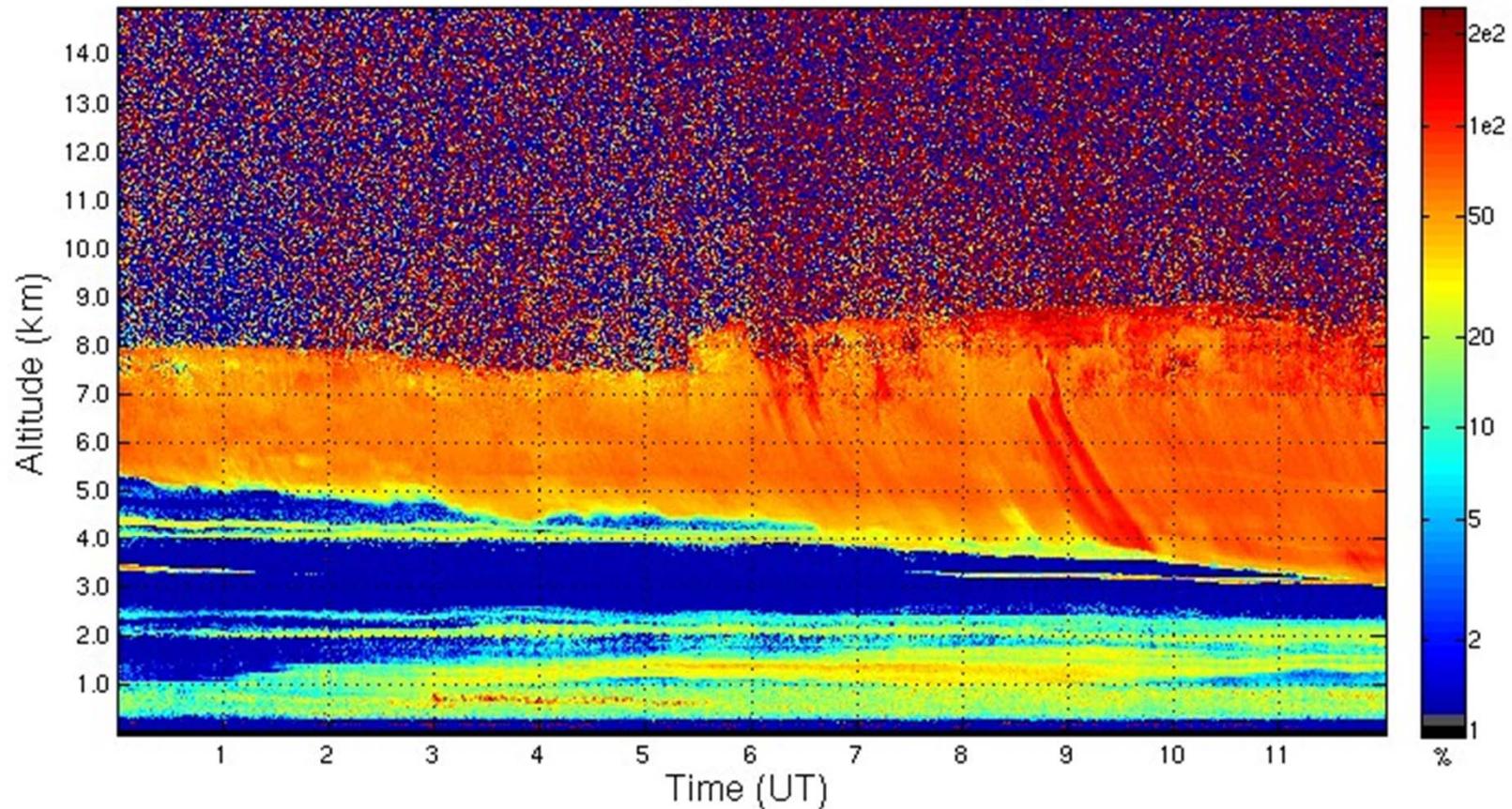


On-demand generated plots...



On-demand plots continued ...

Particulate circular depolarization ratio 04-Apr-2011



On Demand generated NetCDF

From:

year month day hour minute

To:

year month day hour minute

Min altitude: <input type="text" value="0"/> km	Time Resolution: <input type="text" value="30"/> seconds/record	File Mode: <input type="text" value="single"/>
Max altitude: <input type="text" value="15"/> km	Altitude Resolution: <input type="text" value="30"/> meters/point	

[Data Quality Masking](#) (Leave blank to disable)

Minimum Radar Backscatter <input type="text" value="1e-15"/> 1/(m str)	Minimum Radar Reflectivity <input type="text" value="-66.1"/> dBz
Minimum Lidar Backscatter <input type="text"/> 1/(m str)	Lidar Backscatter Signal-to-Noise Ratio <input type="text" value="1"/>
Minimum Molecular Count <input type="text" value="1"/> counts	Molecular Count Signal-to-Noise Ratio <input type="text"/>
Lidar Mask Altitude: 0 to <input type="text" value="100"/> m	Radar Mask Altitude: 0 to <input type="text" value="200"/> m
Lock Quality <input type="text" value="0.6"/>	

Several time selection options

File Mode

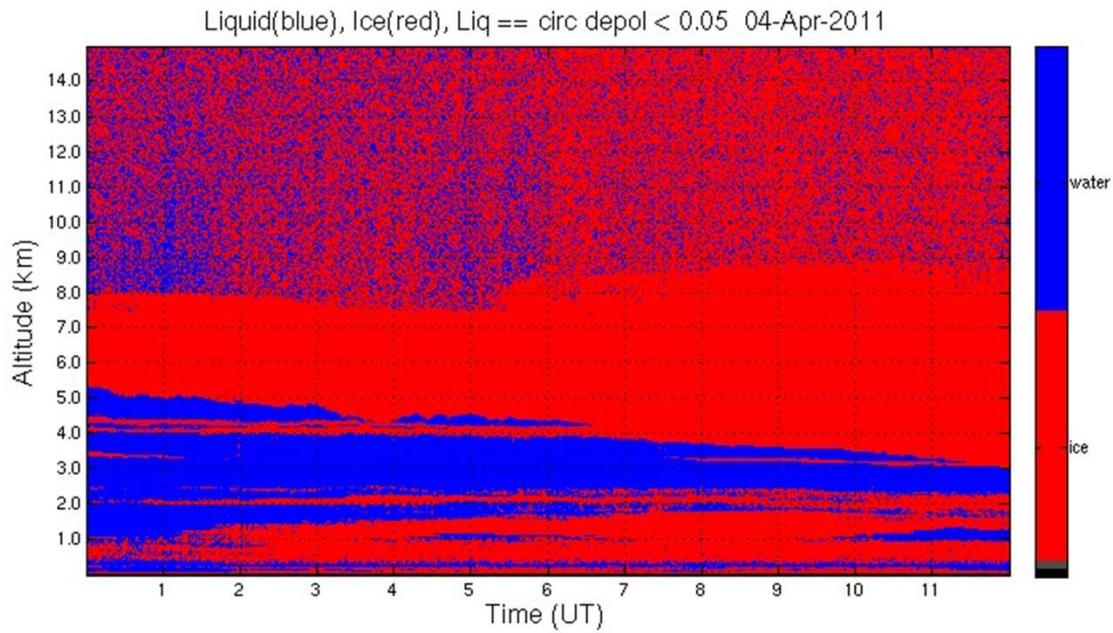
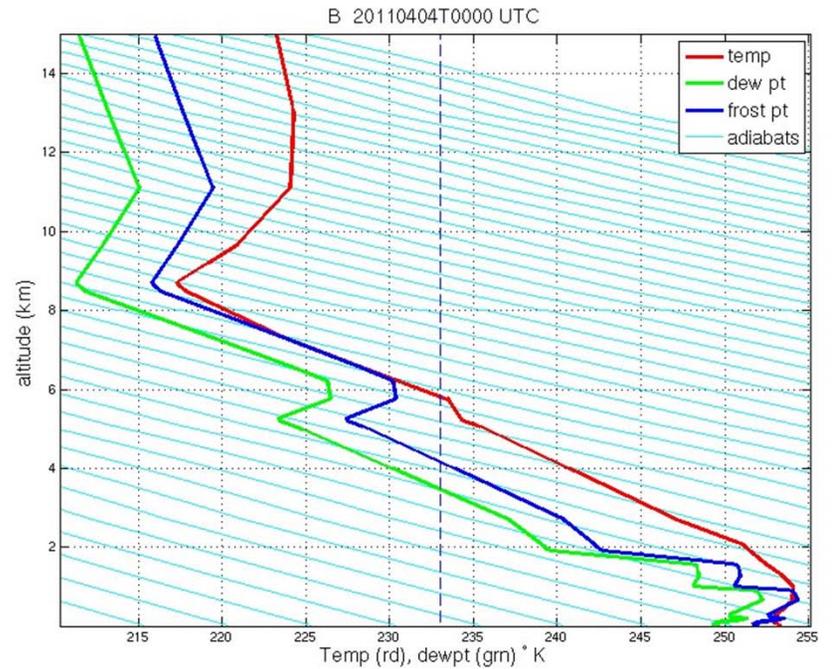
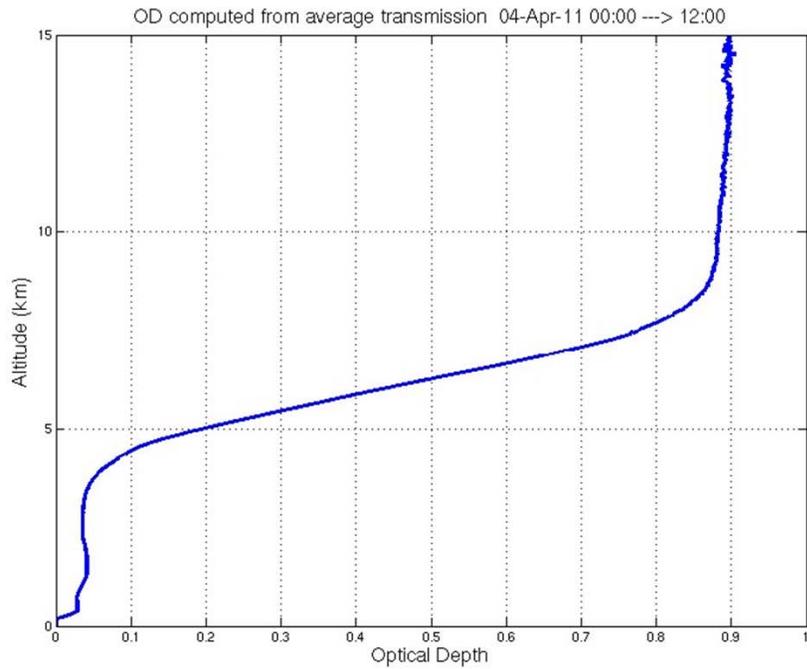
- **single** generate a single file, waiting until the process is complete and return a link to the NetCDF file on this web page. This file begins and ends at the selected start and end times and is uncompressed.
- **30minute, 1hour, 1day, 1month** allow batch mode generation of multiple NetCDF files within the specified time interval. The time duration of individual files will correspond to the selected option (ie, "hour" makes a new file every hour starting on the hour) .
- **routine** generates short duration files at fixed times each day within the specified start to end time period.
- **satellite** calculates when a named satellite is within the specified distance from the instrument site, and creates a file for each such overpass within the provided window.

Customized NetCDF content

In addition to raw lidar and housekeeping data:

Derived Quantities

- Particulate Backscatter Cross Section
- Particulate Optical Depth
- Particulate Depolarization
- Particulate Extinction Cross Section
- Attenuated Molecular Backscatter
- Error Estimates



Can ARM do this too?

- ARM is working to host our own HSRL POD (Processing on Demand), details TBD.
- Possibly hosted on sites, at DMF, or Archive
- SSEC has provided Matlab scripts already.
- We'll begin working the details after the AMF2 installation at Gan is underway.