High Spectral Resolution
LIDAR

ASR Aerosol Lifecycle Working Group
Optical Properties of Aerosols
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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

Mie scattering

Molecular Rayleigh scattering

Iodine Absorption Cell
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 ...
On Demand generated NetCDF

From:
- year: 2011
- month: April
- day: 04
- hour: 00
- minute: 00

To:
- year: 2011
- month: April
- day: 04
- hour: 12
- minute: 00

Min altitude: 0 km
Max altitude: 15 km
Time Resolution: 30 seconds/record
Altitude Resolution: 30 meters/point
File Mode: single

Data Quality Masking (Leave blank to disable)
- Minimum Radar Backscatter: 1e-15 1/(m str)
- Minimum Lidar Backscatter: 
- Minimum Molecular Count: 1 counts
- Lidar Mask Altitude: 0 to 100 m
- Lock Quality: 0.6
- Minimum Radar Reflectivity: -66.1 dBz
- Lidar Backscatter Signal-to-Noise Ratio: 1
- Molecular Count Signal-to-Noise Ratio: 
- Radar Mask Altitude: 0 to 200 m

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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 (i.e., "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:

- 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.