



Upgrades and Additions to the ARM High Spectral Resolution and Raman Lidars

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ARM High Spectral Resolution Lidars

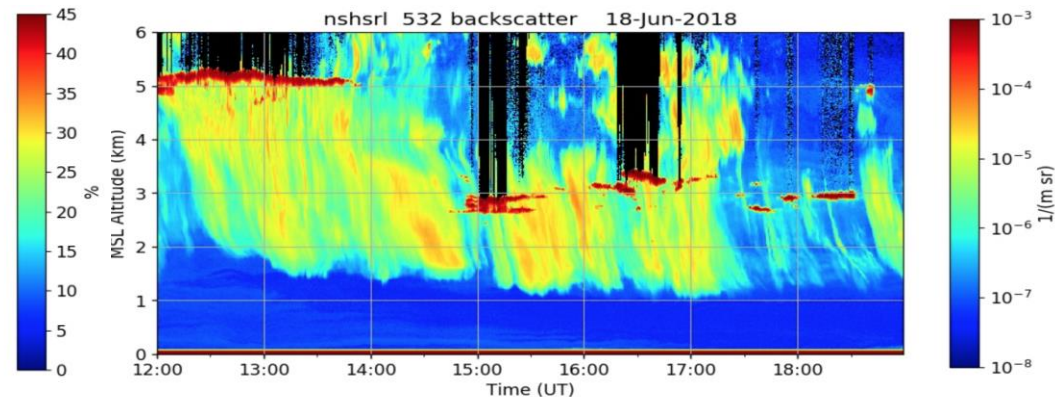
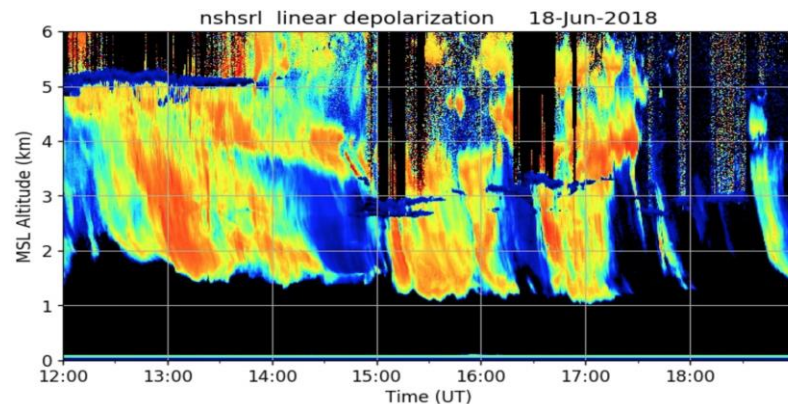
Background

HSRL key features:

- Transmits narrow band pulses (injection seeded laser)
- Separates Doppler-broadened molecular scattering from aerosol scattering using iodine vapor cell (narrow band absorptive filter)
- Measures co- and cross- polarized backscatter (combined molecular+aerosol)

Prior to 2019:

- Two systems: deployed at NSA and with AMF2
- Single wavelength transmission at 532 nm
- Staring off-zenith ($\sim 4^\circ$)

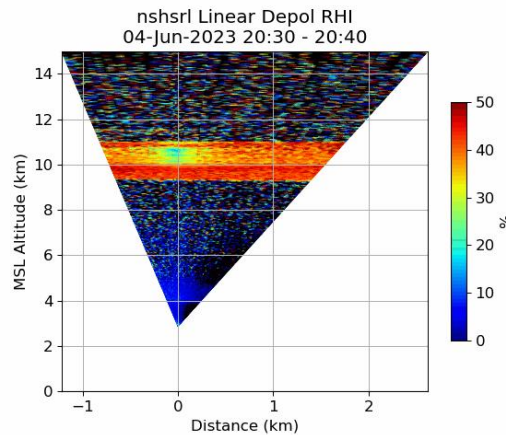
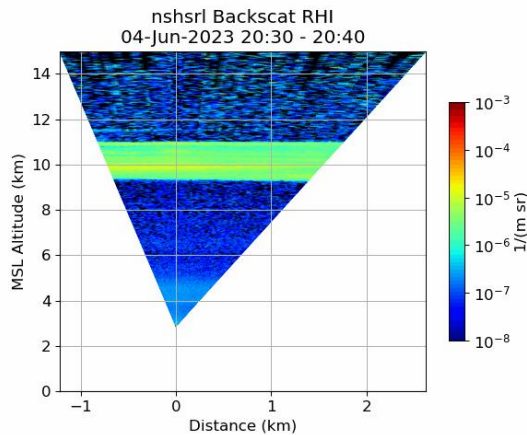


ARM High Spectral Resolution Lidars

Upgrades

HSRL 1 (formerly at NSA)

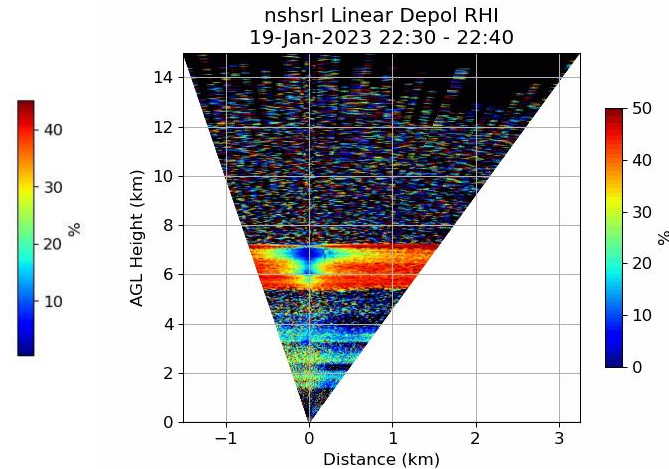
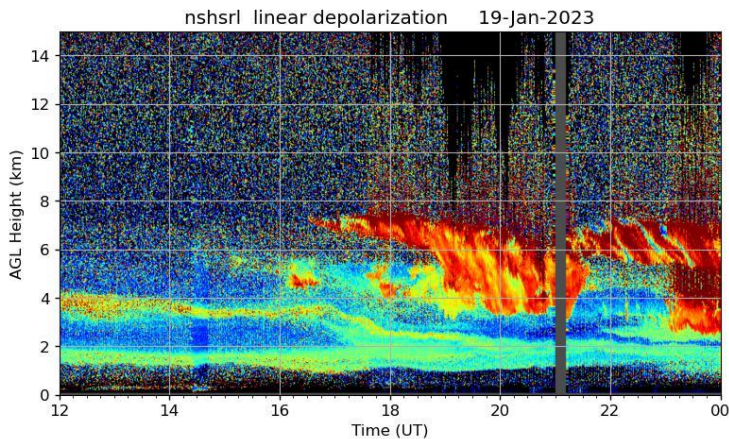
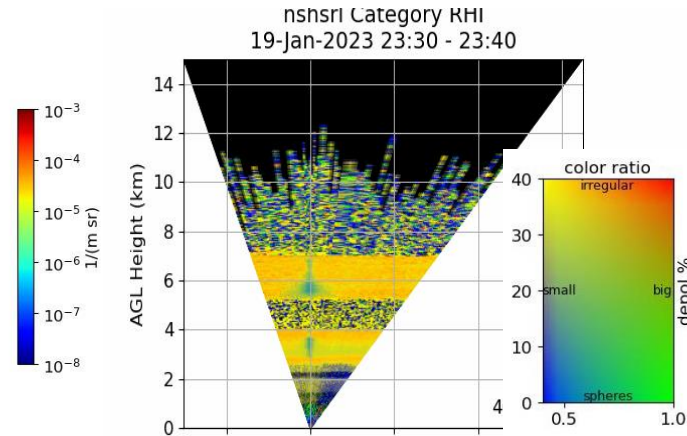
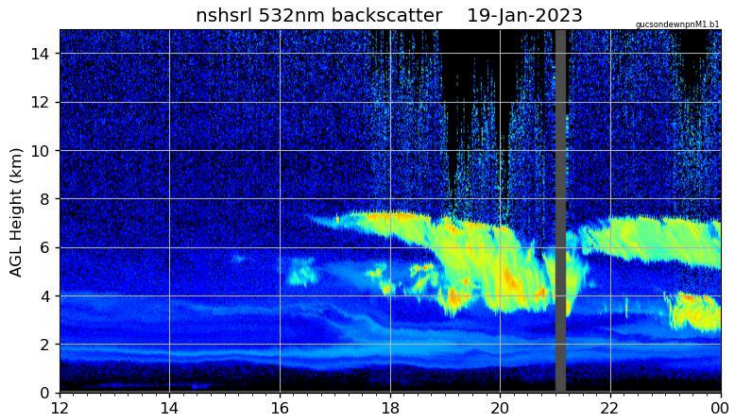
- Dual wavelength operation – transmit both 1064 nm and 532 nm
- Wide field-of-view 532 nm for full overlap below 600m
- 532 nm HSRL operation in narrow and wide field-of-view
- Co- and cross-polarized backscatter signals at 532 and 1064 nm with increased cross-polarization signal
- Scanning around zenith to distinguish aligned ice particles
- Continuous-wave calibration signal to increase calibration signal-to-noise ratio
- Updates to computer and data acquisition



ARM High Spectral Resolution Lidars

More on scanning...

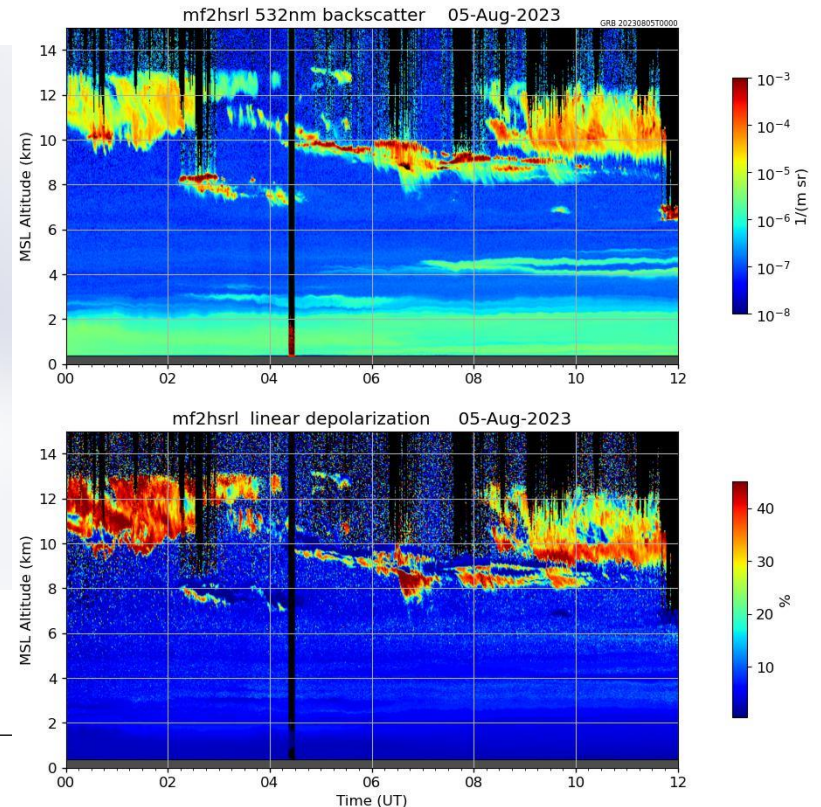
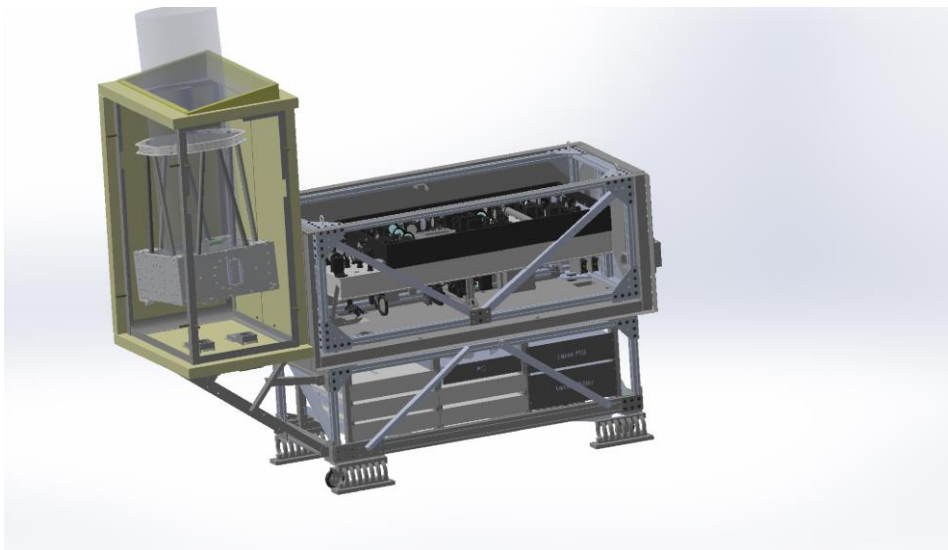
- Scanning around zenith, typically over -6° to $+5^\circ$
- Visualize with range-height plots (2-D spatial slices)
- Generate familiar time-height plots using average of profiles off-zenith (excluding -3° to $+3^\circ$)



ARM High Spectral Resolution Lidars

HSRL 2 (formerly AMF2) and 3

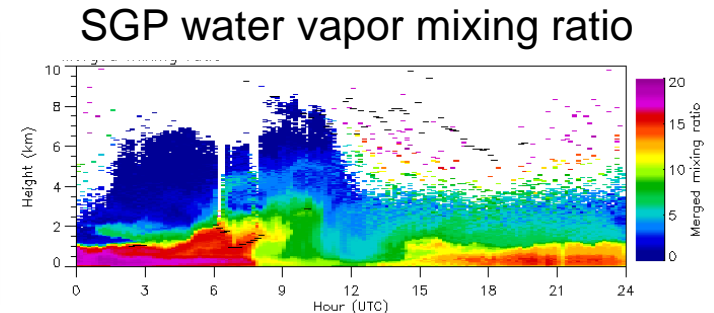
- Incorporate all of the upgrades listed above for HSRL1
- 1064 nm HSRL capability using a Michelson Interferometer
- HSRL 2 is currently running without 1064 nm HSRL in at U.W.
- A new instrument , HSRL3, is under construction at U.W..



ARM HSRL and Raman Lidars

Raman Lidars – SGP, ENA, AMF3

- Measurements: inelastic scattering (Raman) from $\text{H}_2\text{O}_{\text{vapor}}$, N_2 , rotational N_2 & O_2 , elastic scattering (co- and cross-polarized)
- No recent capability upgrades
- We have identified and are remedying the sources of gradual sensitivity degradation
- AMF3 RL sustained damage in shipping between Oliktok and SGP – repairs are underway
- Co-location with an HSRL allows multi-parameter retrievals of aerosol properties



Planned deployments

- HSRL 1 will be deployed at SGP during Fall 2023
- AMF3 RL will be deployed to Bankhead National Forest, Fall 2023.
- HSRL 2 is currently running without 1064 nm HSRL in at U.W. and will be deployed to BNF in 2024 after the upgrade is complete.
- HSRL 3 will be deployed to NSA in late 2024 (at the earliest).



Thank You

