

ARM

Atmospheric Radiation Measurement Program



A Discussion on Raman Lidar Requirements for NSA, TWP, and/or AMF

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Opportunity vs. Need

- Two commercial vendors are offering Raman lidars
- There has been a previously stated need to have more routine measurements of water vapor and aerosol at the other ARM sites
- Need to define:
 - Scientific objectives
 - Variables needed
 - Resolution and accuracy required
 - Which site(s)
- Priority relative to other efforts
- Raman lidar capability is, to first order, related to the power of the laser multiplied by the area of the telescope's primary mirror
 - CARL's laser is 12 W and primary mirror has $D = 61$ cm
- Some measurements are 'free'

What Raman Lidars Can Measure

Estimated CARL accuracies

- Water vapor mixing ratio
 - 10-s, 50 - 350 m, 14 km night, 6 km day
- Aerosol and cloud backscatter
 - 10-s, 50 - 150 m, up to tropopause day and night
- Aerosol and cloud depolarization
 - 10-s, 50 - 150 m, up to tropopause day and night
- Aerosol and cloud extinction
 - 3-min, 300 - 1000 m, up to 10 km night and 6 km day
- Aerosol and cloud extinction-to-backscatter ratio
 - 3-min, 300 - 1000 m, up to 10 km night and 6 km day
- Ambient temperature
 - 30-min, 100 - 1000 m, up to 14 km night and 6 km day
- Relative humidity
 - 10-s, 50 - 350 m, 14 km night and 6 km day
- Associated integrated quantities (PWV, AOT, cloud optical thickness)

An Example Discussion: NSA

- Scientific objectives:
 - Characterize the thermodynamic environment, given the important of infrared radiative transfer in the Arctic atmosphere
 - Cloud extinction and depolarization measurements
- Measurements and accuracies:
 - Water vapor mixing ratio: 15 min, 100 m up to 3 km
 - Temperature: 30 min, 100 m (or better) up to 3 km
 - Cloud depolarization: 30 s, < 100 m in BL decreasing to 300 m at tropopause
 - Cloud extinction profiles: 1 min, 100 m in BL