ARM Atmospheric Radiation Measurement Program

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

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Commercially available vs. custom made Raman lidar

	Commercial system	Custom (similar to the RL at SGP)
Price	Low	High
Delivery time	Short	Long
Size	Compact design	Not so compact
Capabilities *Power of the laser multiplied by the area of the telescope's primary mirror*	laser 1.2W D=40cm It is possible that it cannot deliver the quality RL measurements we desire	laser 12W D=61cm Will be designed to meet our requirements

Need, requirements and priorities

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 (primary and secondary)
  - Range, resolution and accuracy required
  - Which site(s)
  - Is eye-safety operation required
  - Are there any collocated instruments, which can be used to substitute some of the RL measurement
- Priority relative to the other instrument efforts

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