Understanding microphysical properties of clouds and aerosols is crucial to understanding large-scale weather processes. A dearth of high vertical and temporal resolution measurements in the Arctic contributes to modeling uncertainty which directly inhibits understanding of cloud radiative and precipitation impacts on the surface environment. The Summit Polarized Raman (SuPR) lidar will be deployed to Summit, Greenland to measure water vapor, temperature, and polarization profiles.

Calibration

- By taking ratios of different signals, many terms of the lidar equation directly cancel.
- An example of one such ratio is given for temperature retrieval (Figure 11).

Simulated Retrievals

- Using modeled photons, retrieval algorithms can be tested for accuracy.
- Seasonal variations in precision exist due to variations in sunlight and geophysical differences.

Expectations

- SuPR will be constructed in Boulder, CO in 2014-2015 for testing.
- SuPR will be deployed to in 2016 for 3.5 years of atmospheric measurement.
- The design is optimized for the weakest signal, water vapor.

Acknowledgments

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References

- Full STEKCHNICAL Report on water vapor number density to 10% precision to the 7.5 [m] range.
- Measure depolarization with 5% precision to 30 [km].

Simulations

- Full Stokes vector treatment (Equation 1)\(^{4}\). Note the box color around a figure corresponds to color coding in the equation or equation piece.
- Atmospheric data from MSIS or radiosonde.
- Background counts taken from UV spectrometer at Summit.
- Temperature dependent scattering cross sections (\(\sigma_{\text{scat}}\)) for oxygen and nitrogen.

Table 1: Major system parameters of the SuPR design.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Transmit</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Expansion</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Beam Divergence</td>
<td>166 [μrad]</td>
<td></td>
</tr>
<tr>
<td>Pulse Energy</td>
<td>400 [mJ]</td>
<td></td>
</tr>
<tr>
<td>Pulse Rate</td>
<td>30 [Hz]</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Raman backscattering coefficient [m \(^{-1}\)] for oxygen and nitrogen with incident light at 395 [nm]. Light green is rotational Raman from oxygen and dark green from nitrogen. Wavelength bands used are highlighted by purple boxes.

Figure 5: Atmospheric parameters. Water vapor and nitrogen number density are taken from radiosondes at Summit.

Figure 7: Backscattering coefficients [m \(^{-1}\)] for scattering channels demonstrating the critical signal is water vapor. Calculation assumes a rectangular filter function with 0.3 [mm] combined with the information in Figure 1.

Figure 8: Overlap assuming a coaxial design with a 0.252 [mm] field of view with 3 times beam expansion.

Figure 9: Simulated photon count returns for the baseline design for all proposed measurement channels.

<references>