Receiver field of view characterization of the CANDAC Rayleigh-Mie-Raman lidar

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CANDAC Rayleigh-Mie-Raman Lidar (CRL)

- Located at ØPAL in Eureka, Nunavut (80N, 86W)
- Eight-channel lidar measuring ultraviolet, visible elastic, and nitrogen Raman backscatter, and water vapour mixing, temperature, and depolarization ratio profiles

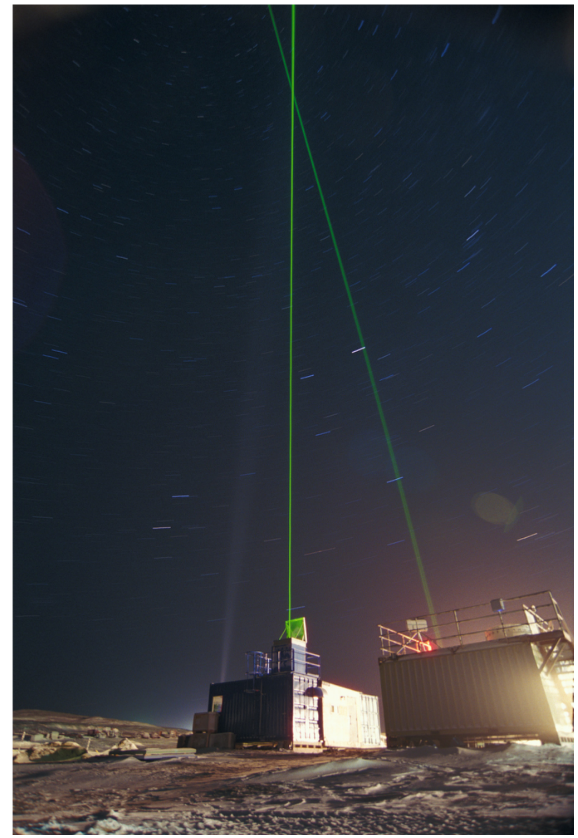


Figure 1. CRL transmitting at ØPAL (photo credit: Graeme Nott).

Objective

- Determine how the field of view and aperture influence both the lidar and background signal

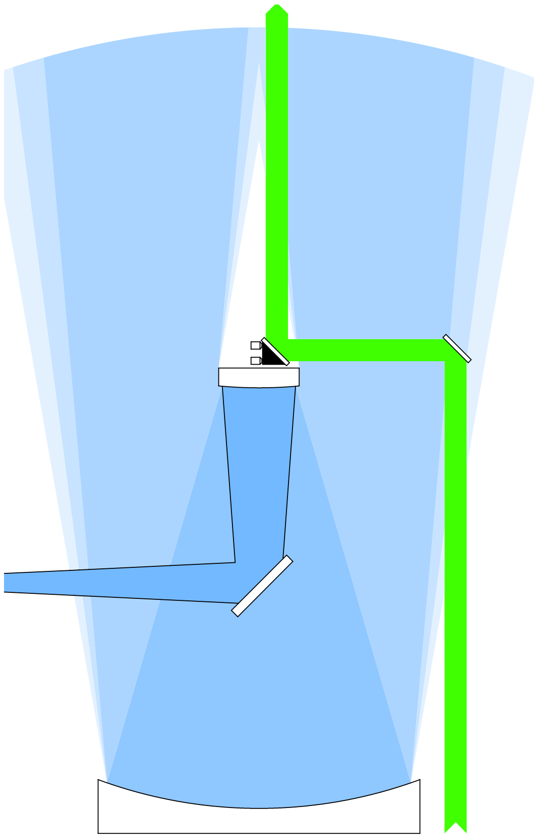


Figure 2. Schematic of the Telescope illustrating the effect of different field of view.

Procedure

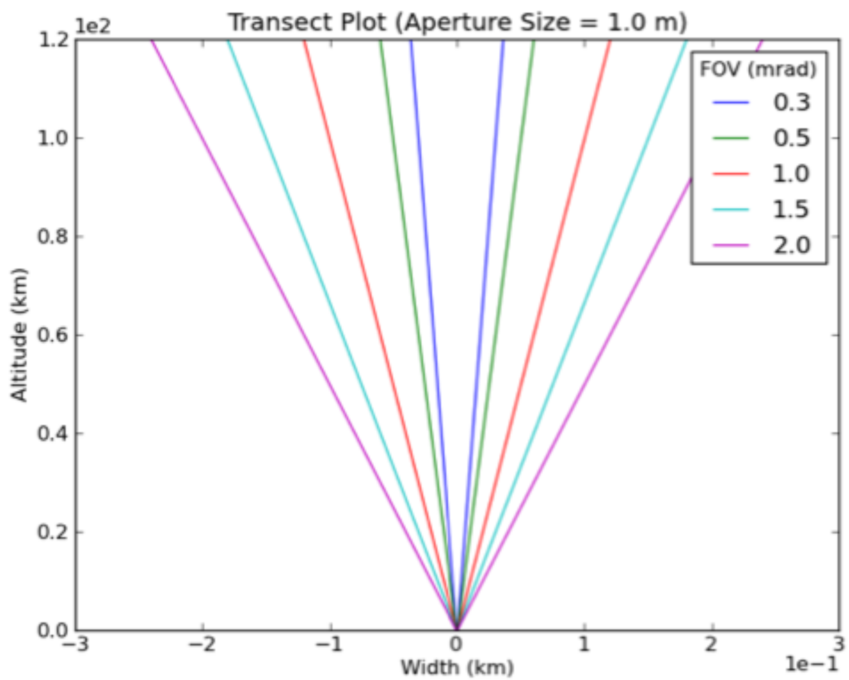
Models were constructed to:

- Examine effect of changing irises on amount of lidar signal
- Characterize effect of field of view and aperture on amount of background signal
- Determine volume inside field of view of telescope, which is proportional to amount of background signal

The entire FOV of the telescope was mapped to:

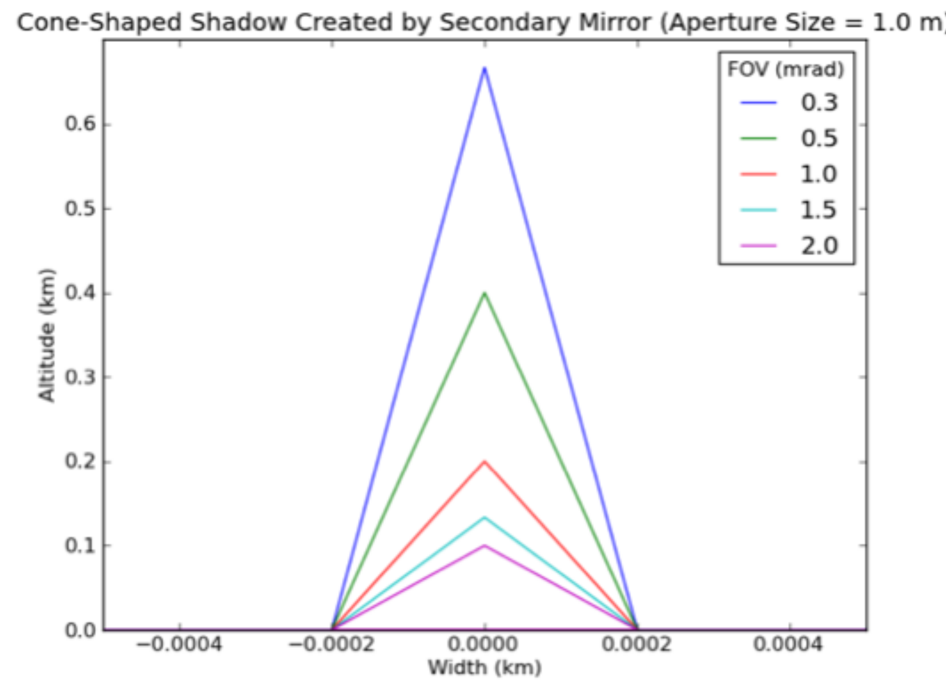
- Provide experimental verification of actual field of view over entire region
- Visualize where routine alignments fit into field of view
- Determine whether or not suggested peak is optimal position

Simulated Volume of the Receiver Field of View



Cross-section transect plot of FOV of the telescope:

- illustrates the truncated cone created by the laser beam
- volume is proportional to the amount of background signal



Close up of the cone-shaped shadow created by secondary mirror

- region where no background signal is received
- height of shadow does not exceed 700 m

Relationship between FOV and background signal

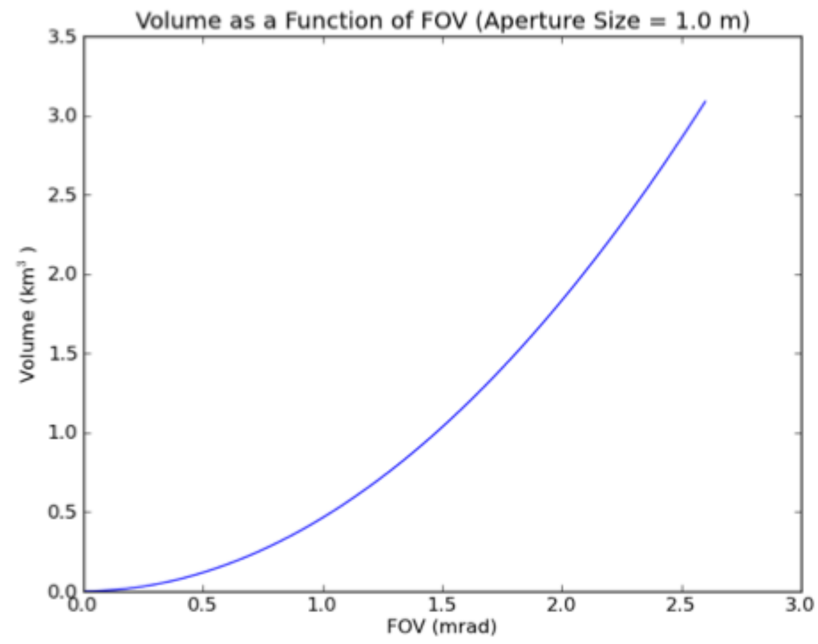
- constant aperture size of 1.0m
- the volume or the amount of lidar signal was determined to be:

If $FOV = 0$ and $r_1 < r_2$: $V = 0$

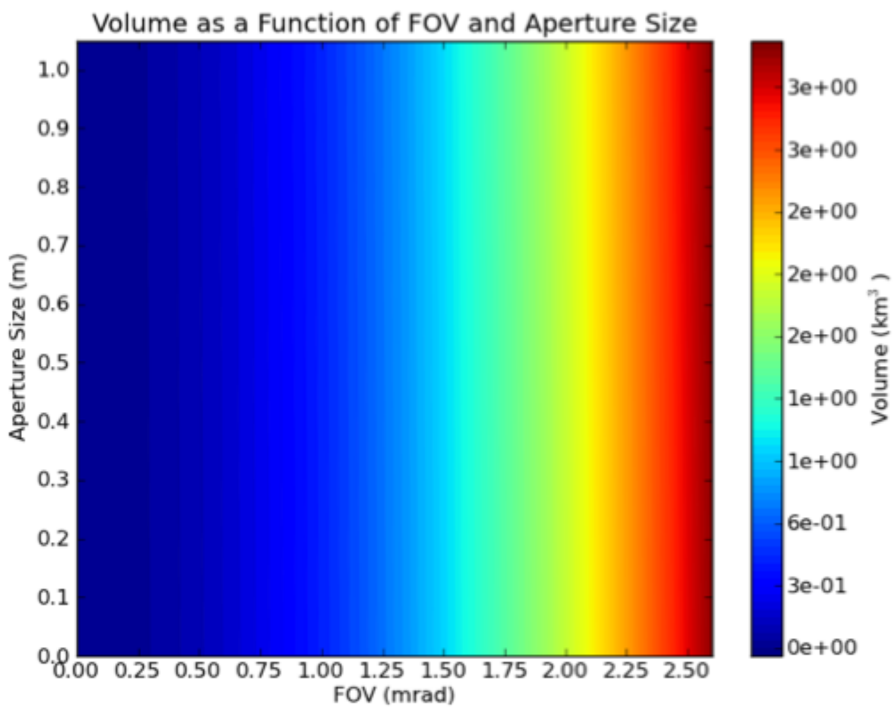
If $FOV = 0$ and $r_1 \geq r_2$: $V = \pi r_1^2 h - \pi r_2^2 h$

If $FOV \neq 0$: $V = \frac{1}{3}\pi h(3r_1^2 + 3r_1 \tan(\theta)h + \tan^2(\theta)h_1^2) - \frac{1}{3}\pi \frac{r_2^3}{\tan(\theta)}$

where, r_1 is the half the size of the aperture, r_2 is the radius of the secondary mirror, V is the volume of the truncated cone, h is the highest altitude at which signal is received, and Θ is half of the FOV.



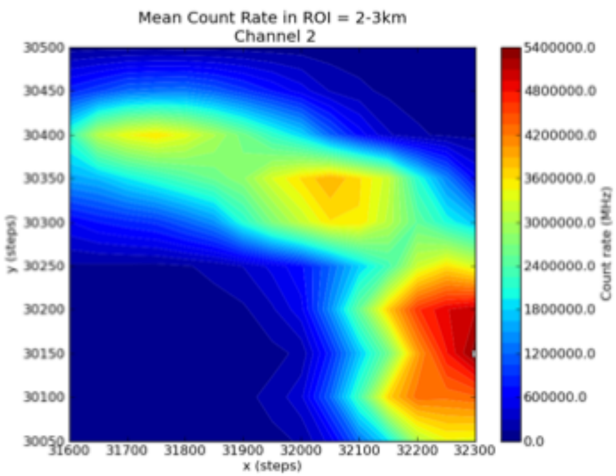
Effect of FOV and aperture on the amount of background signal



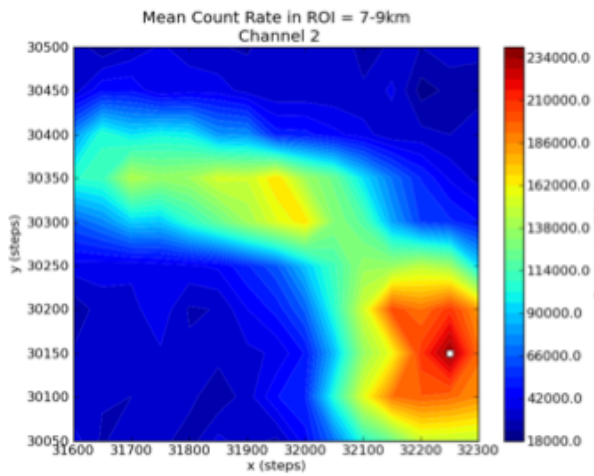
- due to the large volume of the truncated cone, the aperture appears to have very little effect on the amount of background signal

Results

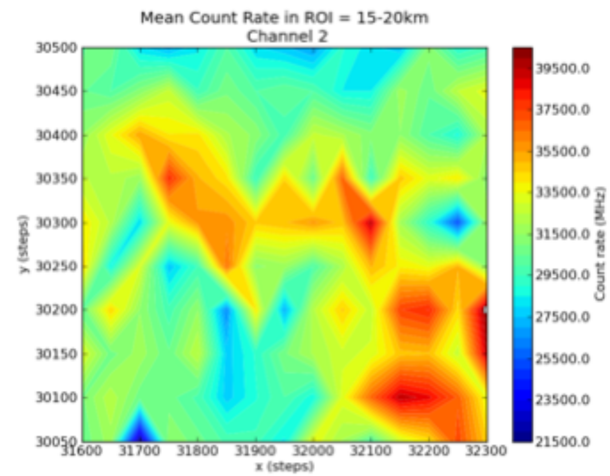
Measured Integrated Signal for Increasing Altitude Regions



ROI = 2-3 km



ROI = 7-9 km



ROI = 15-20 km

Future Study

- mapping over entire field of view at various regions of interest (ROI) at both extremes to observe any changes in amount of lidar signal with altitude
- increasing resolution of the measurements
- comparing theoretical models to experimental data to quantify solar blocking by interference filters
- determining if other variables effect amount of lidar and background signal, and consequently, cause higher than expected overlap altitude

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Inspiring Minds

50 Years • Ans
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Étude du plateau continental polaire

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