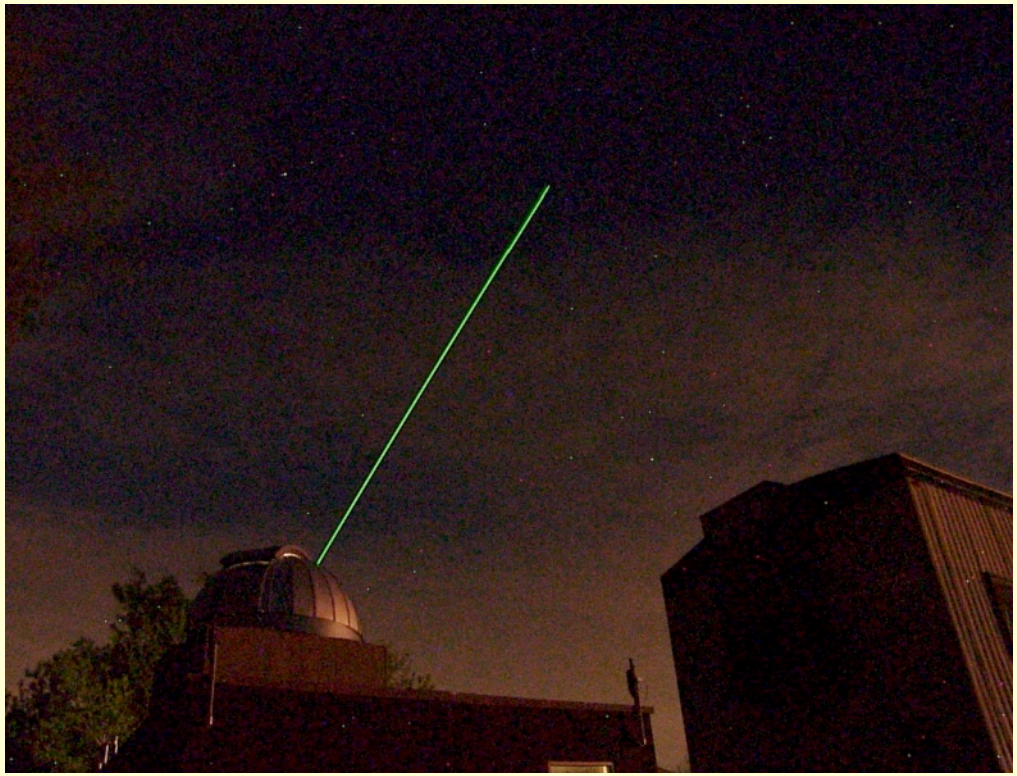
GroundWinds Status Update

Meeting of the Working Group on
Space-Based Lidar Winds

Frisco, CO
30 June 2004

GroundWinds NH

- Direct-detection Doppler lidar
  - Operates at 532 nm
  - 3.5 W @ 10 Hz
  - 0.5 meter aperture
  - High-resolution molecular and aerosol channels
  - CCD detectors
  - 0.7-18 km range ASL



GWNH Status

- GWNH operational (molecular channel only) after various issues
- The aerosol channel will be operational in early July

GWNH Status

- Aerosol camera problems
  - CCD temperature sensor
    - Reinstalled camera 18 June 2004
    - Reinstallation planned early July 2004
- Molecular camera problems
  - Mechanical mounting flaws
    - Reinstalled camera on 10 May 2004
  - TEC not cooling (10 May 2004)
    - Reinstalled camera on 18 June 2004

GWNH Status

- Laser seeder failure (18 March 2004)
  - Age commensurate with lifetime spec
  - Borrowed a seeder from Continuum due to an unanticipated delay in the repair
  - Installed the borrowed seeder on 16 June 2004.

GWNH Status

- Control Computer Failure (4 April 2004)
  - Increased failure rate over the years
  - Purchased, configured, and installed a new control computer on 10 May 2004
- Enough??

GWHI Status

- GWHI is close to being operational after various issues
- Plan to resume daily operations in July

GWHI Status

- PLC power supply failure (16 Feb 2004)
  - Installed replacement unit on 5 March 2004
- Etalon controller failure (7 Jan 2004)
  - Found cause to be a change in the piezo motor polarization induced by long-term contact of high-voltage. Very unusual!
  - Repaired 9 April 2004
- Camera chiller failure (9 April 2004)
  - Optical realignment may be necessary

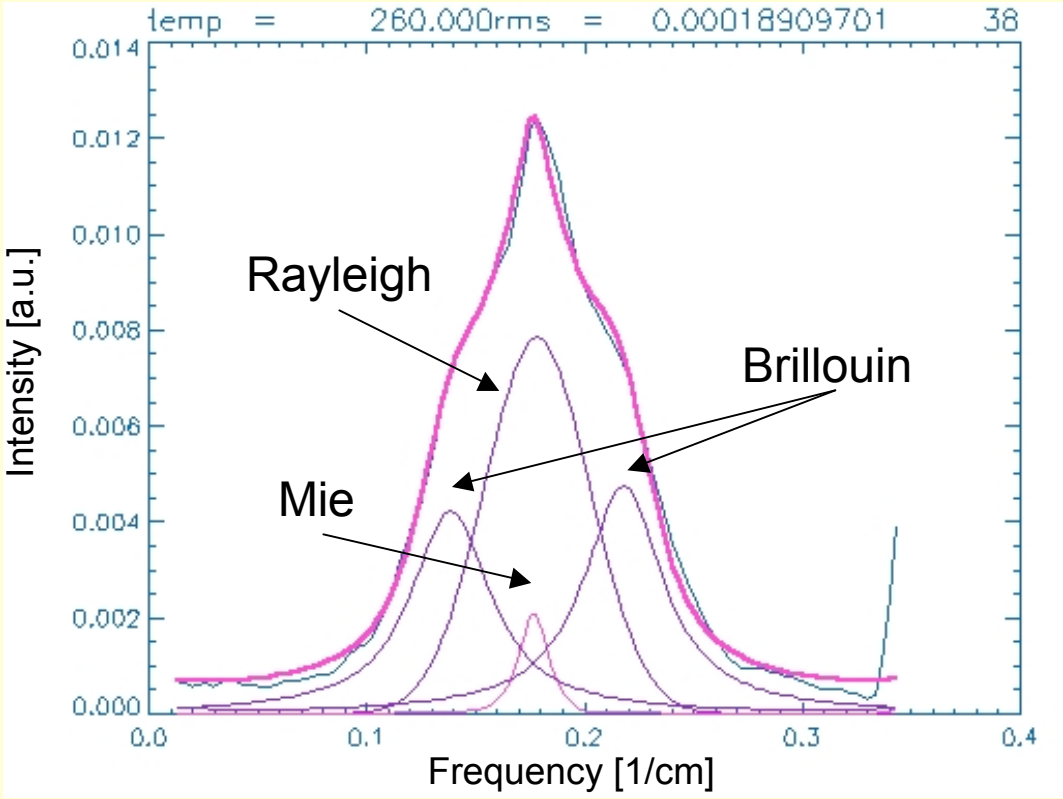
Up-Coming Campaigns

- GWNH: 2004 NEAQS
  - July through mid-August
  - Operate 8 to 10 hours per day
  - Provide wind profiling data for forecast effort
- GWHI: Validation Campaign
  - Week of November 15th
  - Launch 25 radiosondes from up-wind locations
  - Compare lidar and radiosonde velocity profiles
  - Other instruments are welcome!

Data Analysis Efforts

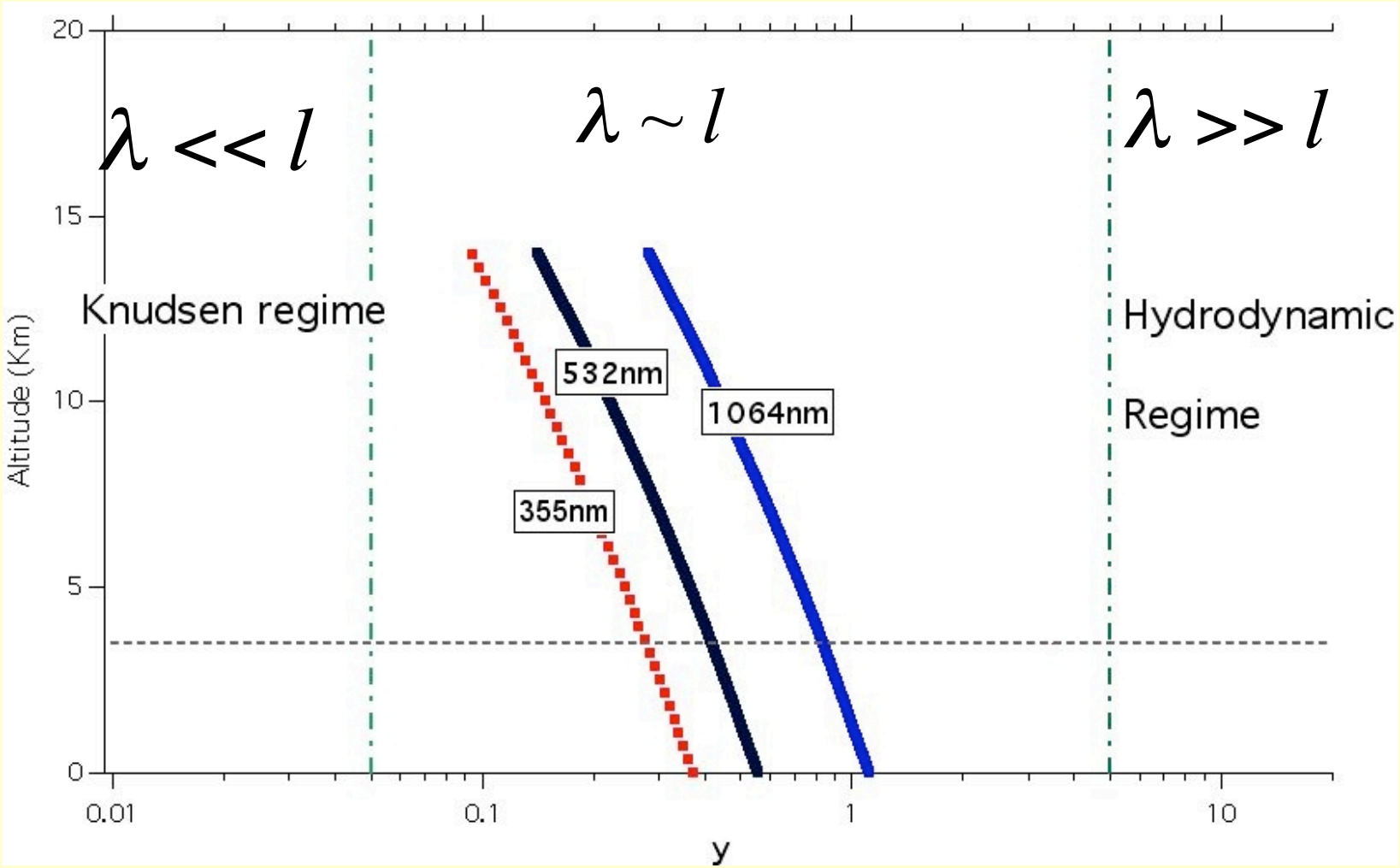
- Calculating **uncertainty estimates** for each data product
- Running **self-consistency tests** to relate discrepancies to statistical, systematic, instrumental, and/or computational errors

GroundWinds Fringe Measurement

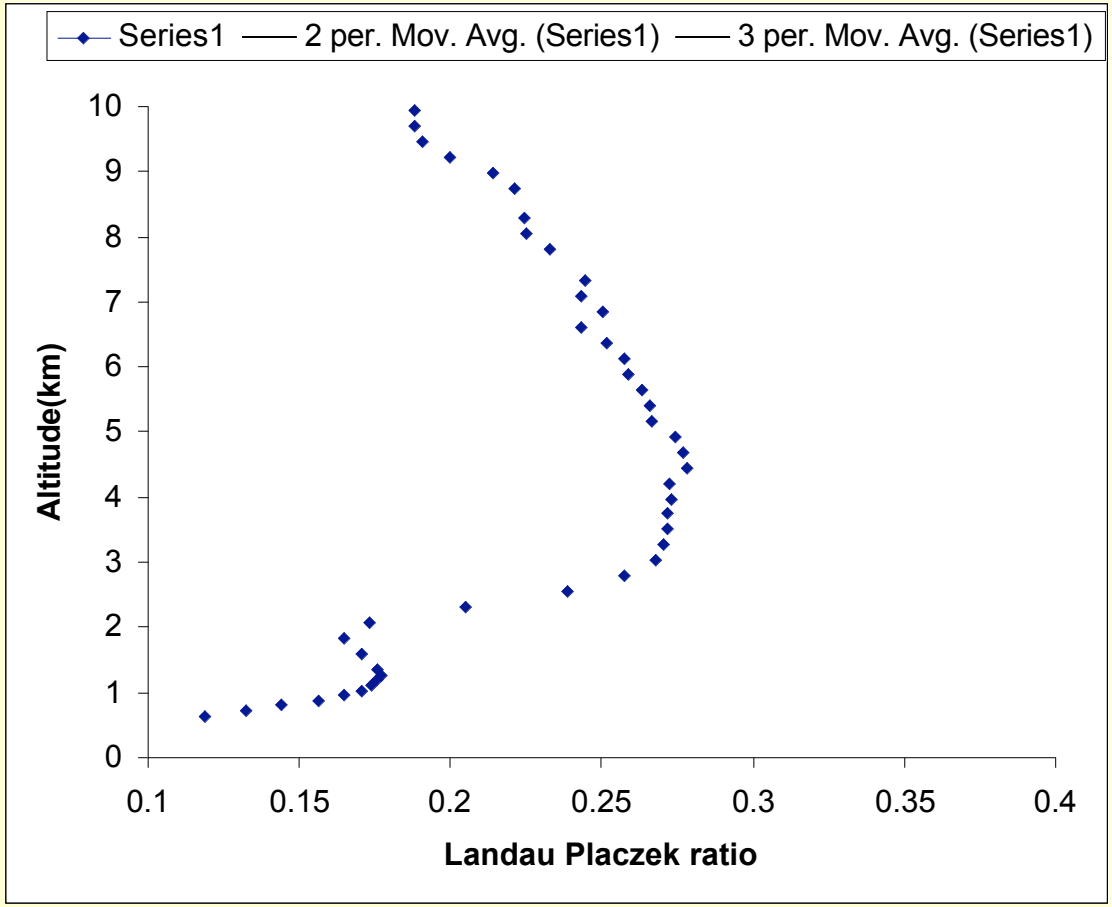


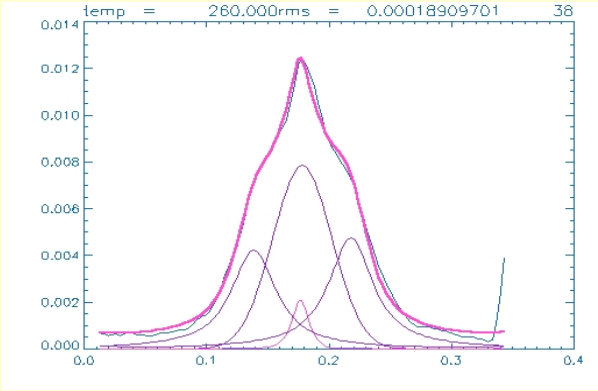
Spectral measurement deconvolved and separated into **Mie**, **Rayleigh**, and **Brillouin** components

Three scattering regimes in the atmosphere



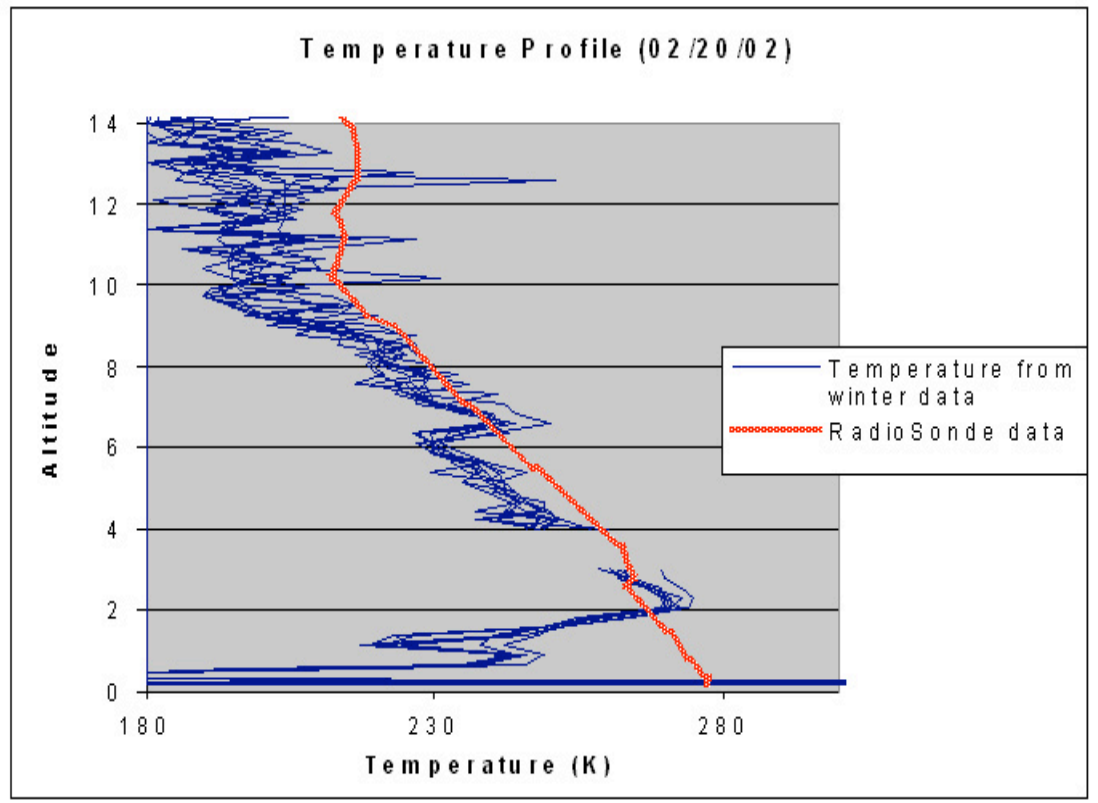
Landau-Placzek ratio





Fringe changes shape as a function of density by changing component magnitudes

Temperature profile



Central peak broadens and Brillouin wings move outward with *T*.

Photometric Return in w/o aerosols

$$P_m(r) \propto \frac{O(r)}{r^2}\beta_m(r)e^{-2\delta(r)} \qquad \delta(r) = \int_0^r \alpha_m(r')dr'$$

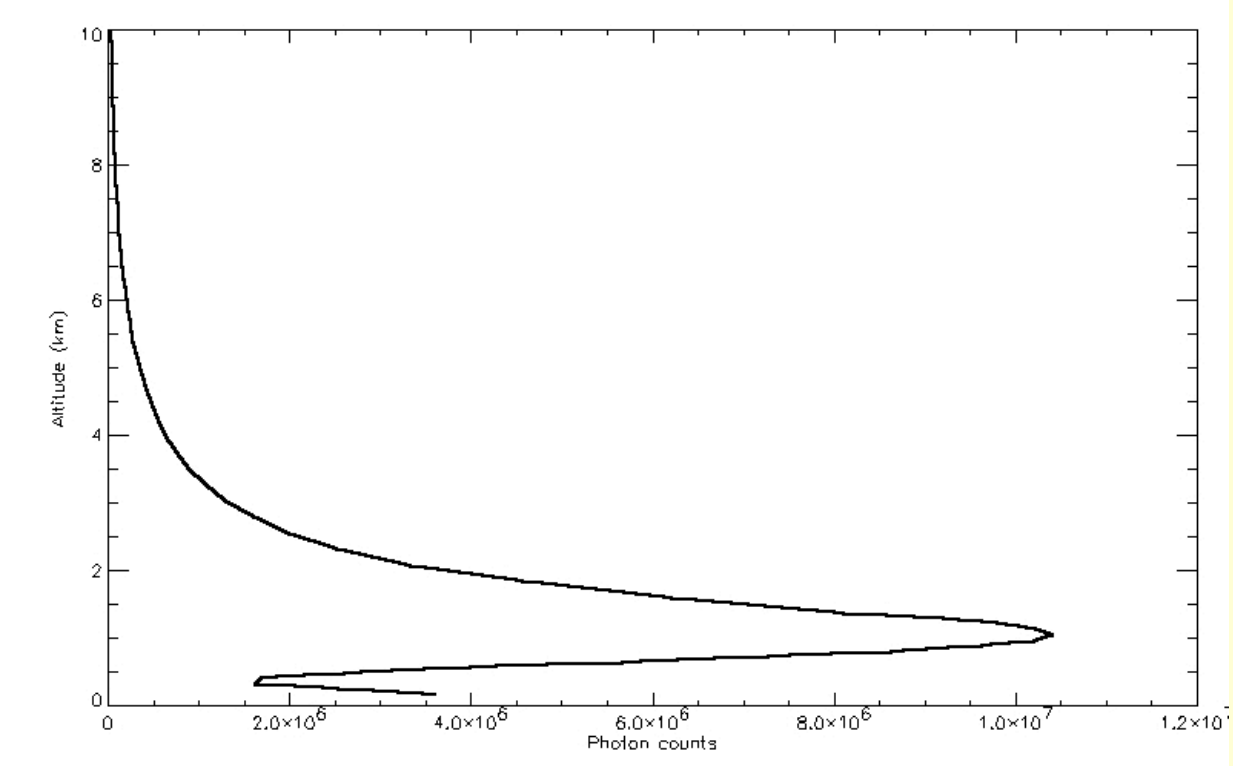
$P_m(r)$ is the photometric return as a function of range, r
$O(r)$ is the overlap function of the laser-telescope system
β_m is the backscatter coefficient for air
α_m is the extinction coefficient for air

Backscatter and extinction coefficients (same physics) related by :

$$\beta_m = \frac{3}{8\pi}\alpha_m$$

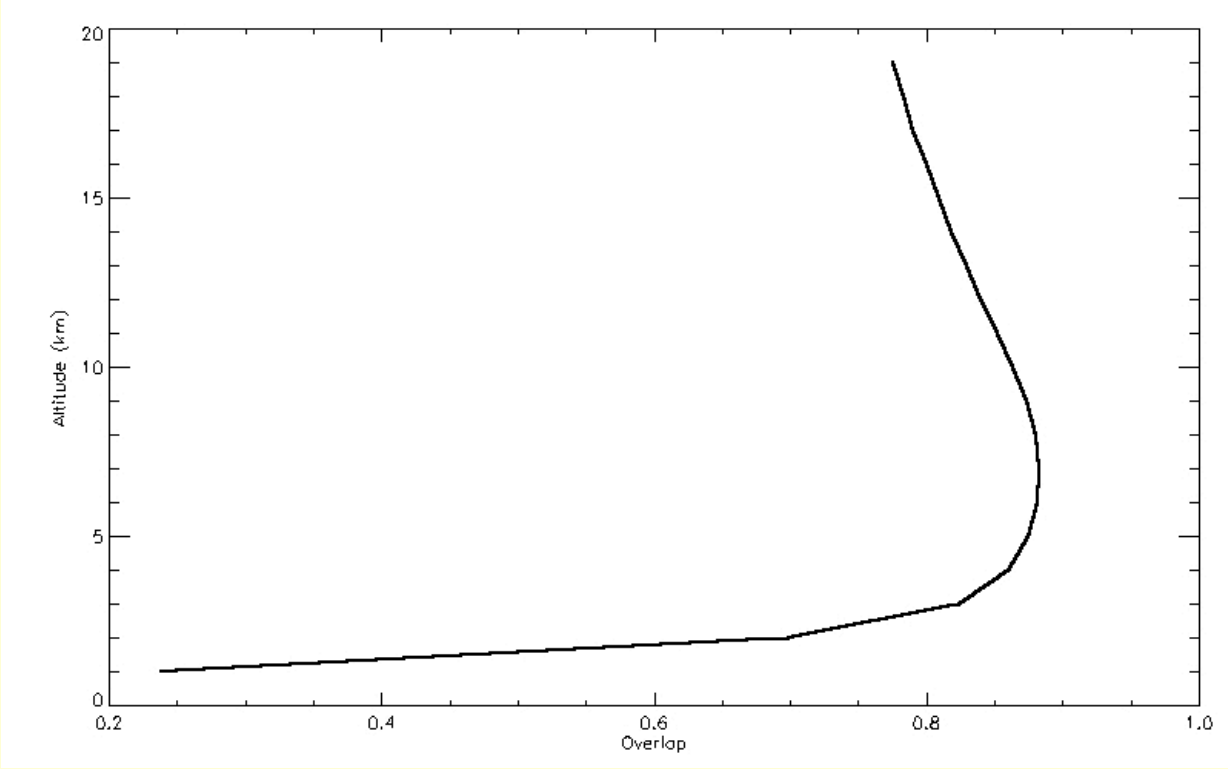
Measured Photometric Return from a 'Clean' Atmosphere

$$P_m(r) \propto \frac{O(r)}{r^2} \beta_m(r) e^{-2\delta(r)}$$



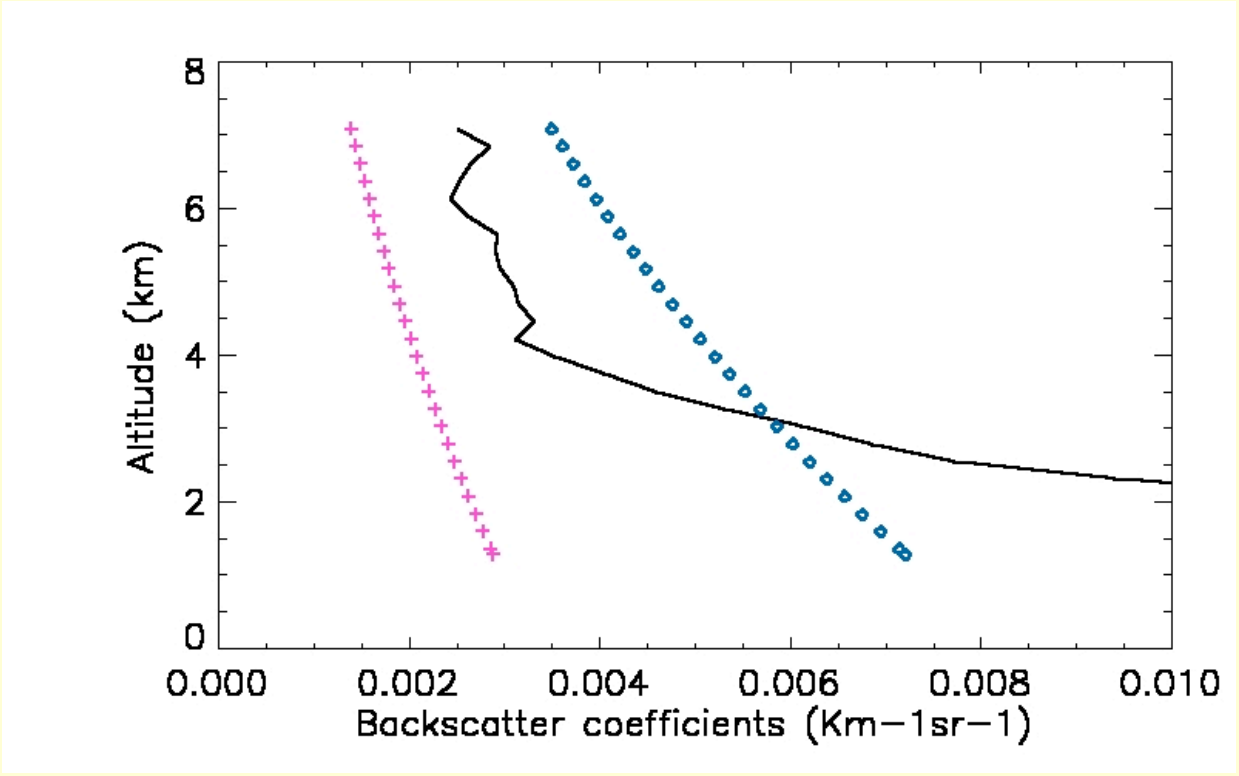
Calculated Overlap Function for the GW Laser-Telescope System

$$P_m(r) \propto \frac{O(r)}{r^2} \beta_m(r) e^{-2\delta(r)}$$

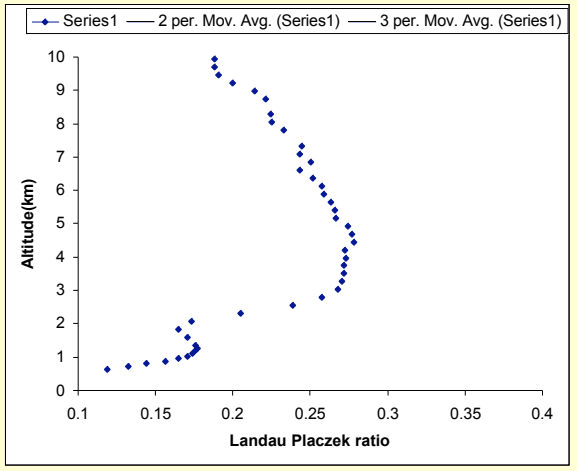


Backscatter Coefficients from Data and Rayleigh Theory

$$P_m(r) \propto \frac{O(r)}{r^2}\beta_m(r)e^{-2\delta(r)}$$

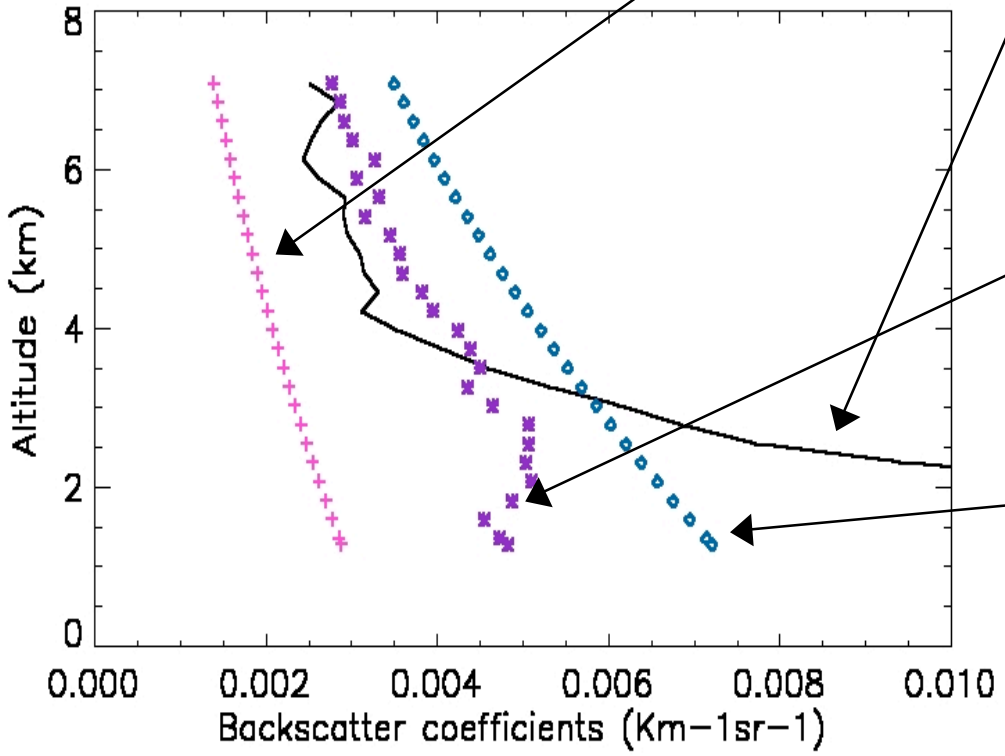


The L-P ratio puts reality somewhere between lines.



Backscatter Coefficients from Data and Rayleigh Theory

$$P_m(r) \propto \frac{O(r)}{r^2} \beta_m(r) e^{-2\delta(r)}$$



Magenta + is theoretical (backscatter coefs) for collisionless air.

Black line is calculated from ***molecular*** photometric returns of GWNH data.

Purple X is calculated using Landau-Placzek ratio ***from GWNH data***.

Blue ◊ is theoretical value assuming air in the hydrodynamic regime (too dense).