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LIDAR METHOD OF MEASUREMENT OF ATMOSPHERIC EXTINCTION AND OZONE PROFILES

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Reported here is a description of a method of measurement of atmospheric extinction and of ozone profiles by use of the backscatter signal from a monostatic lidar. The central feature of the procedure involves a measurement of the ratio of the Raman backscatter returns of both the oxygen and nitrogen atmospheric content. Because the ratio of the number density of both species as well as the ratio of the two Q-branch vibrational cross sections is known to high accuracy, the measurement itself becomes a measure of the ratio of two transmissions to altitude along with a ratio of the two system constants. The calibration measurement for determining the value of the ratio of the two system constants or electro- optical conversion constants is accomplished by a lidar measurement of identical atmospheric targets while at the same time interchanging the two optical filters in the two optical channels of the receiver. Further details of this procedure will be discussed.

Factoring this calibrated value into the measured O2/N2 profile ratio provides a measured value of the ratio of the two transmissions. Or equivalently, it provides a measurement of the difference of the two extinction coefficients at the O2 & N2 Raman wavelengths as a function of the height. A significant body of experience permits the use of a power law as a wavelength scaling law for say aerosol extinction. Thus an aerosol extinction $a(\lambda)$ at a wavelength $\lambda 1$ is related to the extinction of the identical atmospheric target at a wavelength $\lambda 2$ by the expression

$$a(\lambda 1) = a(\lambda 2)\{\lambda 2/\lambda 1\}^{n} \quad \text{Where } 1 \leq n \geq 1.1$$

Should it be argued that the exponent n is really an unknown which can exceed the limits shown, a second procedure is available to measure the value of n as a function of height. This is accomplished by a second measurement of the O2/N2 profile ratio in which the second exciting line is chosen such that the N2 return of the second ratio falls on the same wavelength as the O2 line of the first ratio. Further efforts are being expanded to determine what the measurement of n can reveal about the aerosol size distributions.

Generalizations to include a second type of extinction term such as ozone extinction in the uv are provided for. Complete details for a useful measurement scenario will be discussed.