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# VISIBILITY RELATED TO BACKSCATTER AT 1.54μm

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## ABSTRACT

A need for a remote measurement of visibility is becoming more evident around such facilities as airports, particularly in adverse weather. The lidar process has been shown to have the necessary potential to fulfill this measurement need. From a lidar return optical extinction, hence visibility, can be inferred. The wavelength 1.54μm was chosen, being near the visible wavelength region and having a high eye safety threshold, 200,000 times higher than 1.06μm; 1.54μm is the erbium laser wavelength.

This research utilized 105 measured height profiles of natural droplet size distributions data, taken in clouds, fog and haze. These profiles were examined to determine the completeness of the droplet counting data. It was found that the particle spectrometer data were incomplete in the very light fog and haze so this portion of the data was eliminated.

Utilizing the Mie theory, these droplet size distribution profiles were converted to backscatter at 1.54μm and extinction in the visible region, .55μm. Using Koschmeider's relationship, the extinction profiles were converted to visibility. The visibility and backscatter profiles were compared to develop a relationship between visibility and backscatter at 1.54μm.

The relationship clearly falls into two areas. The first is a hyperbolic portion, covering conditions found in clouds and heavy fog, for visibility extending from 300m to 700m,

$$v=.23/b$$

The remainder of the data, in light fog (visibility more than 700m), falls along a well defined curve:

$$v=3.912/\ln(a+cb)$$

where v is visibility, b = backscatter and a, c and p are constants.

We conclude that a lidar of wavelength 1.54μm has great potential as a remote visibility measurment system.