

THE USE OF LIDAR FOR BOUNDARY LAYER WIND PROFILE MEASUREMENTS

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ABSTRACT

A backscatter lidar system has been used to observe naturally occurring inhomogeneities in the spatial distribution of aerosols. The displacement of these inhomogeneities observed from one laser shot to the next has been used to determine wind component profiles in the atmospheric boundary layer.

In the experiments to be described, time sequences of lidar backscatter profiles were obtained with the system pointed at a small elevation angle. The horizontal wind component along the laser axis was then derived from these time sequences as follows: 1) the individual profiles were combined to form a mean profile, 2) the mean profile was then used to form profiles of the fractional deviation from the mean for each of the original profiles, 3) the individual fractional deviation profiles were digitally filtered to reject small scale structure with short persistence, 4) lag cross correlations were computed between successive filtered deviation profiles in a given altitude range to determine the wind at that altitude.

Comparisons of lidar derived wind components and winds computed from simultaneous single theodolite pilot balloon observations will be presented. One of these comparisons is shown in figure 1. Notice that the deviations between the lidar derived wind profiles and pilot balloon profiles are of nearly the same order as the variations in the pilot balloon measurements themselves.

With careful data processing, the drift of aerosol 'clouds' can be observed even on very clear days. Figure 2 illustrates the persistence and orderly drift of the aerosol inhomogeneities observed on a clear day at a rural site near Platteville, Wisconsin.

7/25/73

----- LIDAR 13:24 → 13:50 CDT
..... PIBAL 12:45 CDT
———— PIBAL 14:24 CDT

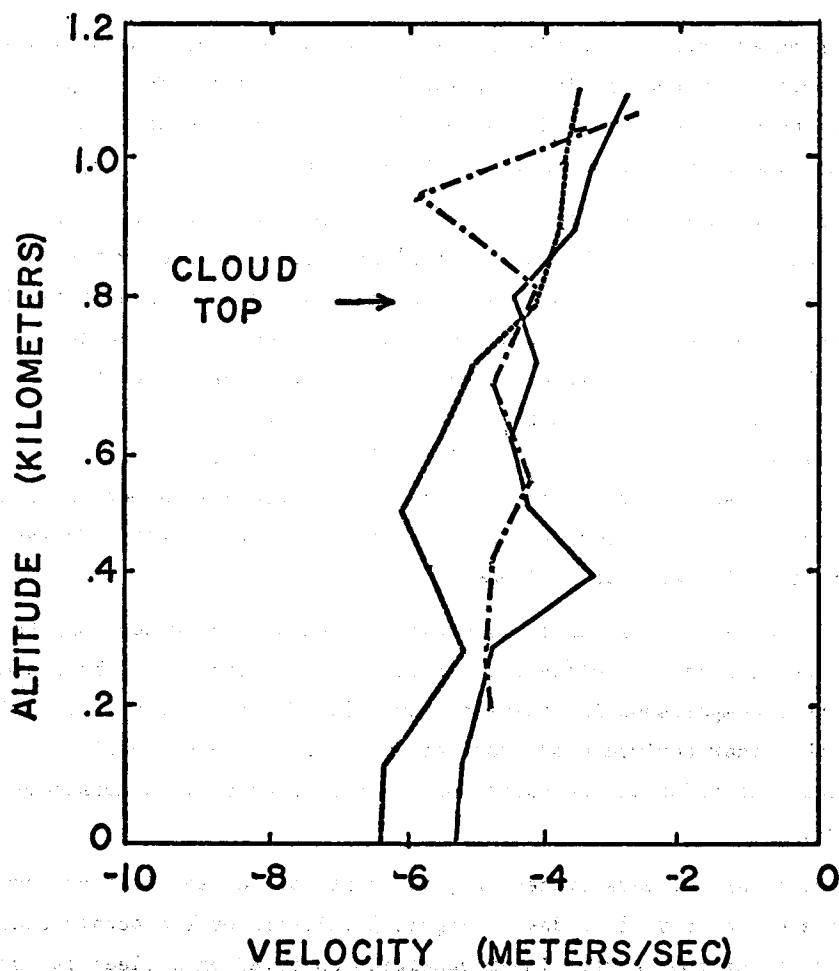


Fig. 1. Wind velocity components along the lidar azimuth. Winds observed in two separate pilot balloon ascents are compared to lidar derived winds.

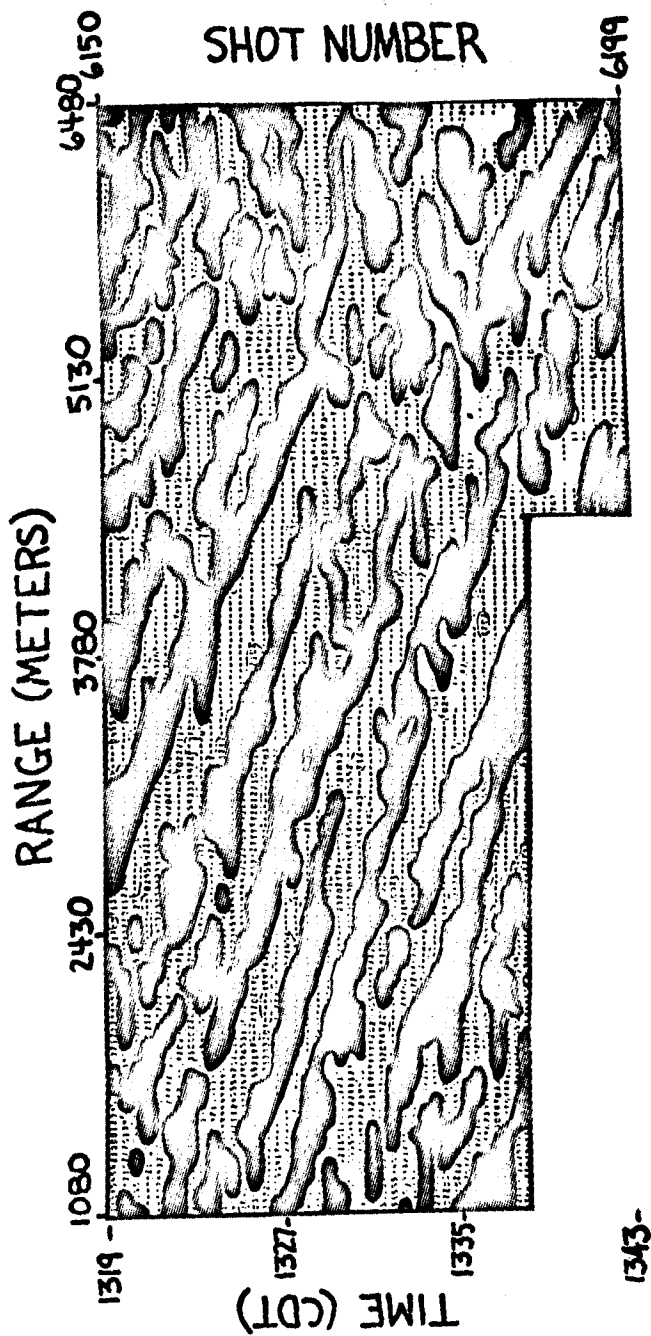


Fig. 2. Range-time-amplitude plot of the inhomogeneities observed in aerosol backscattering on July 25, 1973. Regions of positive deviation from the mean profile are dark and negative regions are light.