TITLE: ANALYSIS OF MSFC GROUND-BASED DOPPLER LIDAR DATA

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SIGNIFICANT ACCOMPLISHMENTS:

1. Analysis of data collected during the participation of the MSFC 10.6 micron pulsed Doppler lidar system (DLS) in the Joint Airport Weather Studies (JAWS) experiment is concluding. It was successfully demonstrated that observations from more than one Doppler lidar can be combined to derive the three-dimensional cartesian wind field. Several dual Doppler analyses (using data from the MSFC and NOAA/WPL lidars) were performed which depicted flow behind gust fronts. All were consistent with surface observations made by the NCAR Portable Automated Mesonet.

2. A comparison of radial velocity estimates at low elevations made by the MSFC lidar and the NCAR 5.5 cm Doppler radar (JAWS experiment) revealed a substantial r.m.s. difference of 3 m/s, and a mean difference of 1 m/s. Both measurement sets were taken within a cold air outflow produced by a squall line. Radar reflectivities were found to be below the level necessary for optimum performance of the radar signal processor; consequently, the radar radial velocity estimates were biased toward zero by ground clutter contamination. It is suggested that the action of the cold air outflow substantially reduced the number of flying insects originally present in the area. Insects are the predominant radar backscatterers at 5 cm, whereas the lidar relies upon the presence of naturally occurring aerosols.

3. Detailed measurements of horizontal wind fields and tropospheric backscatter have been acquired at MSFC during approximately 60 days of operation during the past twelve months. These data will be useful for defining future flight experiments, instrument design and satellite DLS development. The data, collected for a variety of atmospheric conditions, contain mesoscale and microscale phenomena of meteorological interest.

FOCUS OF CURRENT RESEARCH:

1. A study of the sampling characteristics of the MSFC DLS is in progress. Analysis has focussed on 1) a comparison with an instrumented tower, 2) along-wind versus cross-wind measurements, and 3) the effect of variable pulse length. Goals of the study are to 1) better understand DLS wind measurements that compare with traditional

wind measurements, and 2) determine those aspects of DLS wind measurements which cannot be obtained from tradition techniques.

2. Work has begun on the analysis of data collected while the DLS was in the vertically scanning mode to determine vertical profiles of tropospheric backscatter and transmission loss. Preliminary results show that seasonal variations of backscatter observed at MSFC are consistent with previous studies. Moreover, sub-visible cirrus has been found to occur more frequently than heretofore expected. The results of this local study can be used to suggest that the performance of a spaceborne lidar may be better than thought at present.

PLANS FOR FY-1985:

1. Complete the analysis of wind velocity data collected by the MSFC DLS during JAWS. Identify and perform additional collocated comparisons where MSFC lidar and NCAR radar scans overlapped.

2. Complete the study of the sampling characteristics of the MSFC DLS described above. Continue to assess the capabilities and performance of the lidar as a viable mesoscale and microscale reseach tool.

3. Continue analysis of data collected at MSFC to determine tropospheric backscatter and transmission loss. Assess impact of resulting backscatter "climatology" on satellite DLS development.

4. Initiate analysis of MSFC data sets collected during JAWS to determine vertical profiles of backscatter and transmission loss.

5. Demonstrate feasibility of retrieving horizontal winds using only single ground-based Doppler lidar radial velocities. It is proposed that the technique of correlation analysis be used. Several candidate data sets from JAWS and from the ground-based series of experiments at MSFC have been identified for analysis.

6. Participate in the Fall 1984 airborne DLS flight series.

PUBLICATIONS:

Rothermel, J. and D.E. Fitzjarrald, 1983: Dual Doppler lidar measurements of winds in the JAWS experiment. Preprints, 21st Radar Meteor. Conf., Edmonton, Alta., Amer. Meteor. Soc., 579-583.

Rothermel, J., R.M. Hardesty and C. Kessinger, 1983: Dual-Doppler analysis of lidar measurements taken during JAWS. Technical Digest, 2nd Topical Meeting on Coherent Laser Radar, Aspen.

Submitted:

Rothermel, J., C. Kessinger and D.L. Davis: Dual Doppler lidar measurements of winds in the JAWS experiment. J. Atmos. Oceanic Tech.

In Preparation:

Jones, W.D., J. Rothermel and D.E. Fitzjarrald: Ground-based measurements of atmospheric backscatter at CO2 wavelengths. To be submitted to Appl. Optics.

Rothermel, J. and G.D. Emmitt: Sampling characteristics of pulsed CO2 Doppler lidar: ground-based studies. To be submitted to J. Atmos. Oceanic Tech.