TITLE: DOPPLER LIDAR RESULTS FROM THE SAN GORGONIO PASS EXPERIMENTS

RESEARCH INVESTIGATORS INVOLVED:

Dr. William C. Cliff, J. Raymond Skarda, and Dr. David S. Renne
Battelle Northwest Laboratories
Battelle Boulevard
Richland, Washington 99241
Phone: (509) 375-2024

SIGNIFICANT ACCOMPLISHMENTS: FY-84

During FY-84, the Doppler Lidar data from the San Gorgonio Pass experiments were analyzed, evaluated, and interpreted with regard to signal strength, signal width, magnitude and direction of velocity component and a goodness parameter associated with the expected noise level of the signal. From these parameters, a screening criteria was developed to eliminate questionable data. For the most part the author's analysis supports the validity of Doppler Lidar data obtained at San Gorgonio Pass with respect to the mean velocity magnitude and direction.

The question as to whether the Doppler width could be interpreted as a measure of the variance of the turbulence within the DLS focal volume was not resolved. The stochastic nature of the Doppler broadening from finite residence time of the particles in the beam as well as other Doppler broadening phenomenon tend to mask the Doppler spread associated with small scale turbulence. Future tests with longer pulses may assist in better understanding of this subject.

Data taken as the flow exits San Gorgonio Pass was used to calculate the following Spatial Auto Correlations.

- Longitudinal component longitudinal direction
- Longitudinal component lateral direction
- Lateral component lateral direction
- Lateral component longitudinal direction.

These auto-correlations were then used to compute the associated turbulent integral length scales. The Doppler Lidar data from Runs 13 and 14 of Flight 20 which were taken at elevations above grade of 800 and 850 meters respectively. Correlations of the data were performed using data that fell within a 100 meter-wide strip in the direction of interest.

The following is a table of the turbulent integral length scale for the longitudinal component longitudinal direction and for the lateral component lateral direction. The correlations were obtained from Flight 20 Run 13 at an elevation AGL of about 800 meters. Direct integration of the correlations as well as the Dryden approximation were used to compute the integral length scale.

Flight 20 Run Number	Correlation Number	Longitudinal Component-Longitudinal Direction Integral Length Scale (Dryden Approx.) (Meters)	(Integration) (Meters)
13	1	200	164
13	2	350	239
13	3	420	328
13	4	220	134
13	5	400	343
13	6	580	388
13	7	220	194
13	8	220	194
13	9	300	209

Flight 20 Run Number	Correlation Number	Lateral Component-Lateral Direction Integral Length Scale (Dryden Approx.) (Meters)	(Integration) (Meters)
13	1	350	418
13	2	360	478
13	3	580	358
13	4	290	239
13	5	700	537
13	6	700	707

These results appear to indicate that the upper air where the correlations were obtained is tending toward isotropy. These length scales are reasonably close to values estimated in the open literature. It should be pointed out, however, that these data were taken in a region of expanding flow out of the pass. It should also be pointed out that these data are the only spatial data ever obtained over such a large area with such fine resolution.

FOCUS OF CURRENT RESEARCH ACTIVITIES:

Further examination of the detailed large scale turbulence with regard to its correlations, length scales, and spectra in the pass region is being studied. Areas where the flow is not accelerating are also under investigation. A test plan is also being developed which uses the NASA airborne DLS system to investigate the flow phenomena associated with large scale induced motions over and behind complex terrain.

RECOMMENDATIONS FOR NEW RESEARCH:

The NASA Doppler Lidar System should be used to investigate induced motions caused by complex terrain features extending into and through the boundary layer (e.g., such as the flow over an isolated hill which is within the main boundary layer and one that extends above the main boundary layer). The quantitative measure of the flow over and behind such objects would extend existing data bases on Strouhal vs. Reynolds No. and provide the scientific community with increased information on the physical processes which cause turbulence induced shedding.

Characterization of near surface flow patterns in regions of potential hazardous aerosol releases would be extremely useful in the development and verification of numerical diffusion models as well as for the safety analysis of the release of materials hazardous to personnel and/or the affected environment. In many locations of potential hazardous releases to the environment, little information is available as to the flow path that the release would take under prevailing wind conditions. Actual flow data would be valuable to validate or verify the models which are currently being considered for use.

LIST OF PUBLICATIONS IN FY-84

None. Spatial correlations and length scales being submitted to JAS.