TITLE: Overview of Mesoscale Research Doppler Lidar Activities

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Significant Accomplishments to Date in FY84:

1. Analysis of 1981 ADLS flight data: Analysis of the data obtained in 1981 has continued. During FY84, ten scientists or groups were engaged in various aspects of the work. A number of publications, conference proceedings, and student theses have resulted and are listed elsewhere in this volume. In addition to this scientific work, and in keeping with the program goal of evaluating the performance of the airborne Doppler lidar system, a large number of deficiencies or mistakes have been identified in the original system and experiment plans. All of the known problems have been addressed and corrected in the planning and engineering for the fall 1984/spring 1985 ADLS flight series.

Thus, the most significant result of the data analysis has been the input it has provided to the preparations for the new experiment. Attitude measurement and beam pointing have been vastly improved. When these improvements are taken together with the streamlined operating procedures, color graphics realtime displays of data, and better experiment design, the result is a second-generation system that is considerably better than the one used in 1981. With any luck at all in the weather, we should be able to make some scientifically significant measurements in the new flight series.

2. Planning for 1984/1985 flight programs: A number of proposals have been received regarding the flights. The experiments include mesoscale flow and pollution transport, isolated mountain flows, sierra waves, marine boundary layer structure, severe storms, and flow about complex terrain. Planning has proceeded with ARC, and a tentative schedule has been prepared.

3. Ground-based lidar experiments: Data analyses by Rothermel and Emmitt are reported elsewhere in this volume. In addition to its scientific value, this work has been useful in adding to our understanding of the lidar system and in identifying hardware components that need to be overhauled before the new flight program.

Plans for FY85·

The flight meso experiments will start in August 1984 and end in September. The first portion of FY85 will thus be taken up with initial data analysis and system evaluation. We expect to have from the fall 1984 flights some quick-look publications and some preliminary wind fields before the start of the spring 1985 flights. The spring flights will be primarily mountain waves and severe storms. Following the flights there will be data evaluation, quick-look science, and the starting of scientific analysis of the data.

Recommendations for new research:

New research in this area should include additional scientific analysis of the data that we obtain in FY84 and FY85. We will expect to obtain considerably more than the initial research contracts can handle. Because of the considerable capability that has been developed, consideration should be given to the use of the lidar system in some of the field programs coming up in the next few years.

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⇨ **Analysis of 1981 Airborne Data**

1. Radar lidar comparisons

   a. Doviak et al., NSSL
      o clear air, boundary layer

   b. Srivastava, U. Chicago; Lee, Lassen Res.
      o chaff, deep boundary layer

2. Gust fronts, outflows

   a. Bluestein, et al., U. Okla
      o NSSL radar

   b. Emmitt, Simpson Assoc.
      o CCOPE

3. Complex terrain

   a. Cliff, et al., Battelle
      o mountain pass, surface data

   b. Carroll, UC Davis
      o thermally forced mesoscale, tower

4. Cloud dynamics

   a. Telford, DRI
      o cloud turret

   b. McCaul, U. Okla
      o cloud edge entrainment

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⇒ **Ground-Based Experiments**

1. Rothermel, USRA

   a. JAWS, Denver 1982
      o Dual Doppler lidar
      o Radar/lidar comparisons

   b. MSFC, 1984
      o Single Doppler winds
      o Atmospheric backscatter

2. Frost, FWG Assoc.

   a. MSFC, 1983
      o Aircraft/lidar comparisons
      o Gust probe, turbulence

3. Emmitt, Simpson Assoc.

   a. JAWS, 1982
      o complex terrain

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1981 Flight Results:

1. **Science**
2. **Improvements**
   a. **Experiment Design**
   b. **System**

      Hardware and Software
      Preflight tests, calibration

   c. **Data Analysis**

SCIENCE

1. Analysis of wind data by 10 scientists/groups.
2. Feasibility demonstration.
   - o Boundary layer structures
   - o Gust Fronts
   - o Measurement technique comparisons
   - o Complex terrain

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Improvements in Experiment Design

- o CV990 operational limitations
- o Keep flight tracks simple
- o Avoid short, fragmented runs
- o Longer range with long pulse

Improvements in System

1. Scanner control
2. Attitude measurement
3. System control
4. Data display
5. Optics/laser refurbishment
6. System sensitivity analysis

Scanner Control Improvements

1. Fast response to attitude change
   - o keep beam in desired plane
   - o reduce jitter within averages
   - o follow target at 10 deg/sec
   - o 1 deg change in 50 msec
2. Flexible scanning patterns
   - o more than 15 angles in 4 sec
   - o 180 deg scans at 2 Hz

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▽ Attitude measurement improvements

1. 3 sources of roll,pitch,true heading

   o new ADLS INU (20 Hz)
   o CV990 INU
     aircraft interface (100 Hz)
     ADDAS (10 Hz)

2. 3 sources of drift angle,ground speed
   o new ADLS INU (10Hz)
   o CV990 INU (1 Hz)

▽ System Control Improvements

1. Data transfer
   o async only

2. Simplified
   o 1 computer with coprocessors

3. User friendly operation
   o fast response to changing conditions

4. Additional data
   o Navigational data at 10 Hz

▽ Data Display Improvements

1. Color line-of-sight scalar display

   o velocity
   o intensity

2. Time history of any variable

3. Vector field display

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Improvements in Preflight Tests, Calibration

1. System integration at MSFC
2. Simulation of flight
3. Calibration of system sensitivity
4. Beam pointing calibration
   - o preflight (MSFC)
   - o after CV990 installation (Ames)

Data Analysis Improvements

1. Keep MSFC product simple
   - o gridded line-of-sight winds
2. Look at low-level products first
   - o line-of-sight velocity
   - o intensity
   - o avoid vectors, vorticity, divergence
3. Use interactive graphics
   - o color spatial display of scalars