50

# N90-12066

TITLE: Low Level Remote Sensing: Orographic winds

INVESTIGATOR: Dr. Walter Frost
FWG Associates, Inc.
Tullahoma, TN 37388
(615) 455-1982

SIGNIFICANT ACCOMPLISHMENTS:

The orographic flow data set was obtained from a flight program to measure the influence of orographic features on turbulence momentum, heat, and moisture fluxes. The flights were carried out in Boulder, Colorado, February 1984. The NASA B-57 aircraft instrumented with probes for measuring the three fluctuating wind speed components, temperature, and humidity was the primary measuring vehicle. Ancillary measurements were made with several ground-based sensors provided by NOAA and NCAR. These include the NOAA radar wind profilers, the Boulder wind network, the PROFS mesoscale surface network, the Boulder Atmospheric Observatory 300 m tower, special rawinsonde observations, and the NOAA/WPL Doppler lidar. The major objective of the flight program was to provide planetary boundary layer parameter information for new and current general circulation computer models.

Data were gathered on February 1 and 10, 1984, while the upper level winds (above 10,000 ft msl) were blowing from west to east (perpendicular to the mountain range) and on February 2 and 6, 1984, when the upper level winds were blowing at 301$^o$ and 312$^o$ from true north. This direction represents prevailing winds which are oblique (approximately 50$^o$) to the mountain range. Characteristic wake flow patterns were observed for the differing wind directions. Analysis of the data suggest a shear layer emanating from the mountain peak and propagating downstream and a recirculation region reattaching about 6 mountain heights downstream.

Observations from the February 2 and 6 events (flow oblique to the mountain range) showed a very unique wake flow pattern. The data indicate a strong vortex causing recirculation at the surface. Based on the heat flux measurements made with the aircraft, there is no evidence that these flows are thermally driven. The flow patterns for the February 2 and 6 events correspond with those observed by Zipser and Bedard [1]. Strong vortices shed from isolated mountain peaks were embedded in the overall vortex wake produced by the composite mountain range. The data clearly show an intense wake shed by the semi-isolated peak of Boulder Mountain.

To develop a fundamental and scientific understanding of this flow phenomenon, which may be the cause of severe upslope and strong vortex-like wind conditions in Boulder, Colorado, a water tunnel simulation of flow over a mountain range was carried out. A triangular mountain barrier with a conical peak was used to simulate the mountain range. This simple geometry was utilized primarily to understand the interaction between horseshoe vortices produced by the conical peak and recirculating wakes induced by flow separation behind the large barrier to the flow. Preliminary experimental results have been completed and clearly demonstrate strong wake interactions.

A numerical code, WINDER, based on a discrete element technique [2] has been run to numerically model the water tunnel simulated flow. Comparison of the analytical model with the experimental results is very good. Physical fluid dynamic principles embedded in the computational model and visual and hot wire anemometer measurements from the simulation are being rationalized to develop a physical understanding of the vortex flow. The results will be interpreted as they pertain to full scale atmospheric flows.

<u>STATUS</u>:

This effort has been completed.

<u>REFERENCES</u>:

1. Zipser, E.J., and A.J. Bedard, Jr. "Front Range Windstorms Revisited: Small Scale Differences Amid Large Scale Similarities," Weatherwise, pp. 82-85, April 1982.

2. Eraslan, A.H. "A Transient, Two-Dimensional, Discrete-Element Model For Far-Field Analysis of Thermal Discharges in coastal Regions," Progress in Astronautics and Aeronautics, ED.: J.A. Schetz, Vol. 36, AIAA publication, MIT press, Cambridge, MA, 1975.