Western Region Technical Attachment
No. 91-05
February 5, 1991

CHARACTERISTICS OF A MESOSCALE SNOW EVENT OVER NORTHERN UTAH

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Mesoscale disturbances are, on occasion, much more efficient snow producers than synoptic scale systems. Unfortunately, they are much more difficult to analyze and forecast, even with the resolution of today's models. The forecaster must rely on observation and interpretation of both real-time data such as satellite imagery, alternate diagnostic programs, the models, and experience. Such was the dilemma on 7 January 1991, when a poorly handled short wave produced up to 12 inches of snow in northwest Utah between 00Z and 12Z 8 January 1991.

The dynamic evolution of this system involved a variety of processes. Its passage across northern Utah was documented well by the Dugway (DPG) wind profiler and a mountain wind station.

NGM synoptic analysis at 12Z 7 January 1991, (Fig. 1) featured a short-wave trough sliding northeastward through the Pacific Northwest with a series of minor disturbances in a west-southwest flow across northern Nevada and northwest Utah. In reality, satellite imagery (Fig. 2A) indicated the Pacific Northwest system was an occlusion with a trailing baroclinic zone extending from southern Idaho/northwest Utah offshore through northern California. A cyclonic arc near 40N/130W pinpoints a disturbance along the boundary.

During the afternoon of 7 Jan, water vapor imagery (Fig. 2B) revealed a growing dark zone over northern California suggesting intensification of the disturbance. By 00Z 8 Jan, 250 mb data (Fig. 3A) indicated a jet streak over northwest Nevada supporting the increasing strength of the short wave. Another jet streak over southern Nevada was associated with the subtropical stream. Upper air diagnostics at 00Z 8 January had a convergent Q field over northern Nevada embedded in a thermal wind trough (Fig. 4). Advective processes would spread this implied UVV area into northern Utah during the succeeding 12 hours.

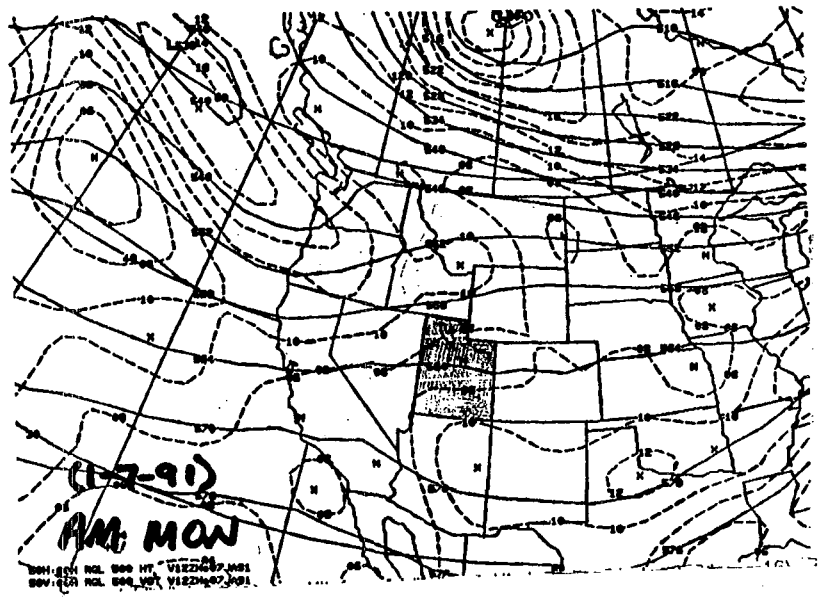
Ambient atmospheric conditions over northwest Utah, as noted in Fig. 5, were very moist and marginally unstable. Static stability (SI=+4, K=19) was low enough to be effectively overturned by the approaching dynamics.

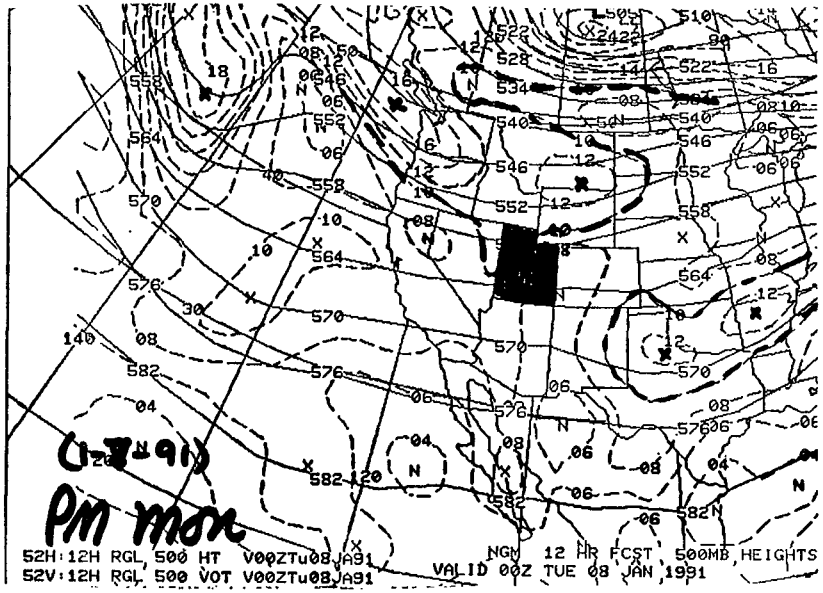
The short wave continued to intensify as it moved east across northern Utah into southwest Wyoming by 12Z 8 Jan. Image Fig. 2C at 07Z reveals a broad dark zone in the water vapor image extending across central Nevada into central Utah. The wave's passage was documented by the DPG profiler, Fig. 6. Strong winds descended to near 550 mb at 10Z. A mountain wind station at Sundance Ski Resort, (elev 8300 ft) due east of DPG also reflected a brief marked increase in speed between 09Z-10Z. Reported winds at 09Z were 160 degrees at 23 knots. At 10Z, winds were 160 degrees at 48 knots. By 11Z, winds were 180 degrees at 23 knots. The wind direction at Sundance is altered by terrain, but the increase is still remarkable given the sensor location is down wind (east) of a 11,500 ft mountain ridge.

Satellite loop imagery suggests mechanisms responsible for the observed intensification. Increasing magnitude and areal extent of the water vapor dark zone associated with the northern California short wave during the afternoon of the 7th indicated organized cold advection (subsidence) occurring in mid-levels. The disturbance was embedded in a baroclinic zone trailing from a filling occlusion. As the wave moved into northern Nevada, it may have phased with the southern boundary of the broader synoptic trough.

Strongest water vapor warming occurred along and to the right of the northern Nevada jet streak seen in Fig. 3A. Enhanced cloud tops associated with the most intense precipitation developed in the left front quadrant of the dark zone. Hence, a clear indication that transverse vertical motions associated with the jet streak were important contributors to this event. 250 mb data at 12Z show the second jet streak which was over southern Nevada at 00Z had apparently raced northeastward and phased with the trough over northern Colorado. Perhaps this southern feature was reflected to some extent in the wind descent noted at DPG and the mountain sensor.

In brief, an intensifying mesoscale disturbance affected northwest Utah during 00Z-12Z 8 January 1991 with up to 12 inches of snow. Dynamic development was likely jet streak secondary circulations (possibly multiple jet streaks) acting upon a prepositioned moist unstable air mass. Modern technology such as water vapor imagery, profiler data, and remote sensing stations closely monitored the developmental sequence and recorded its passage.





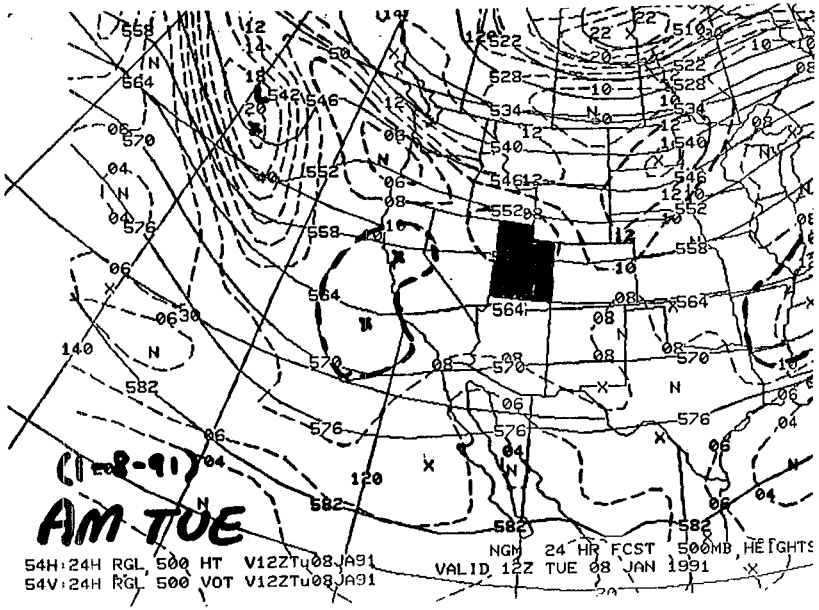


FIG 1. NGM INITIAL, 12, 24 HR HEIGHTS (SOLID) AND VORTICITY (DASHED) FROM 12Z 7 JAN 1991

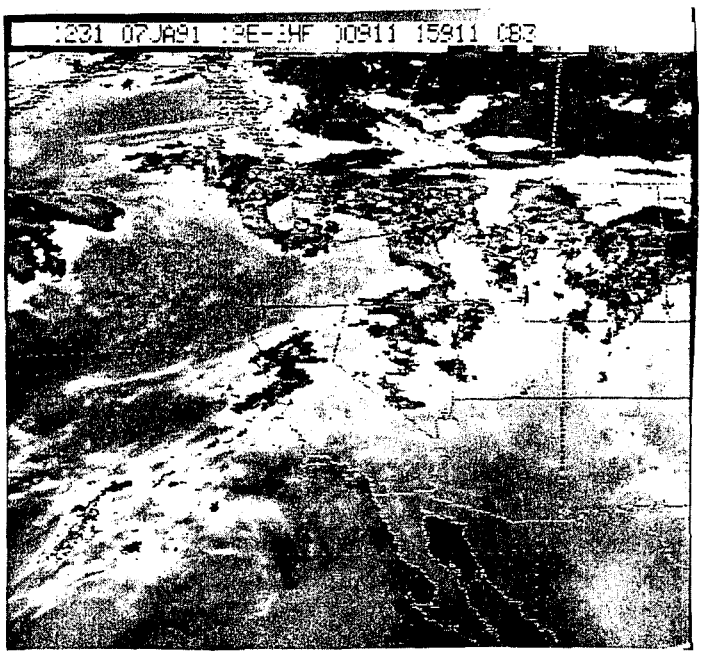


FIGURE 2A

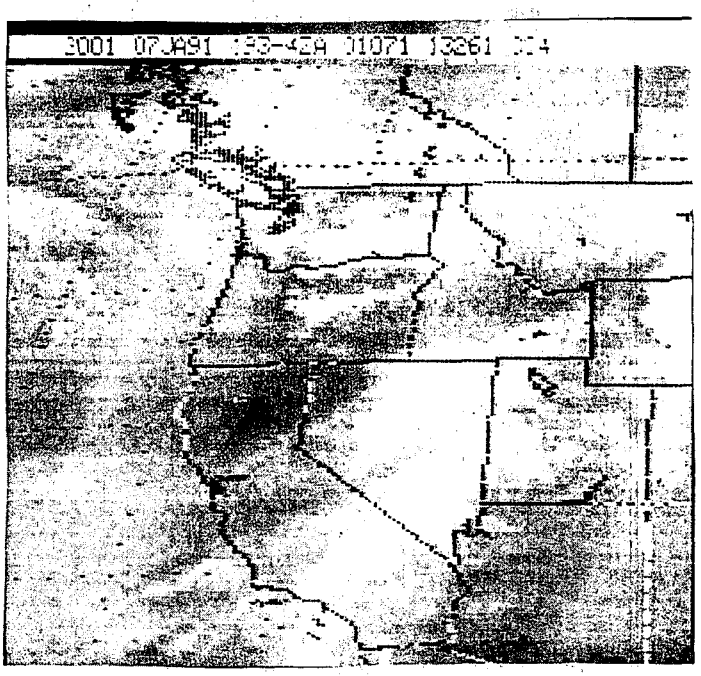


FIGURE 2B

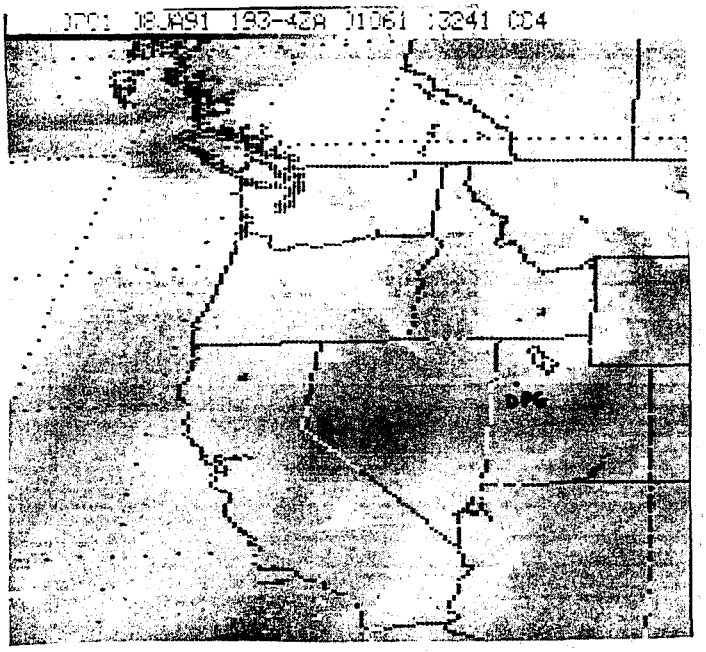


FIGURE 2C

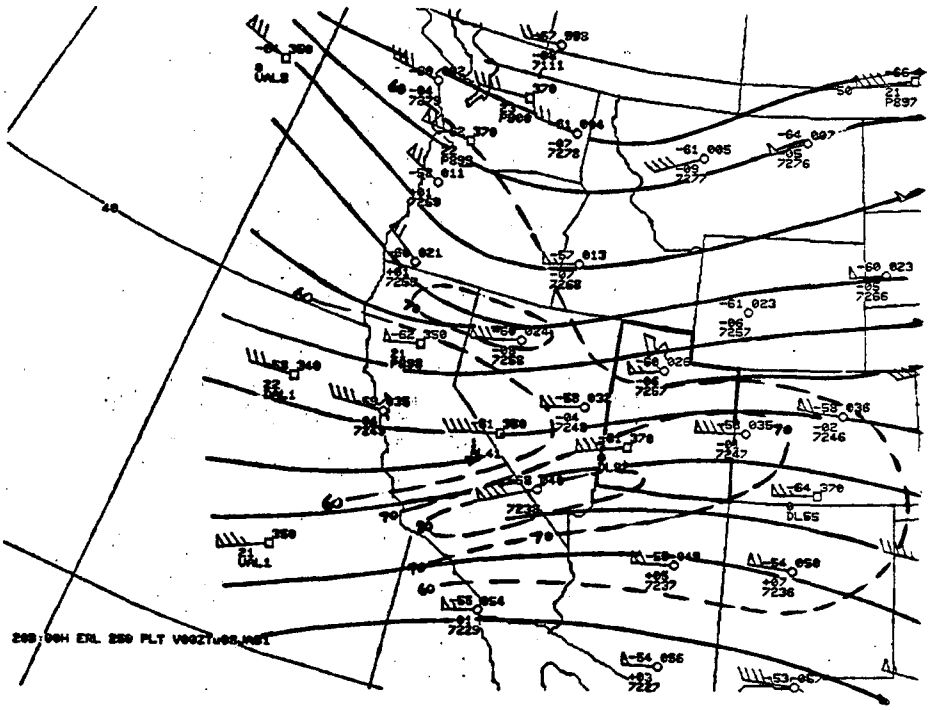


FIG 3a. 250 mb hts (solid) and isotachs (dashed) for 00Z 8 Jan 1991

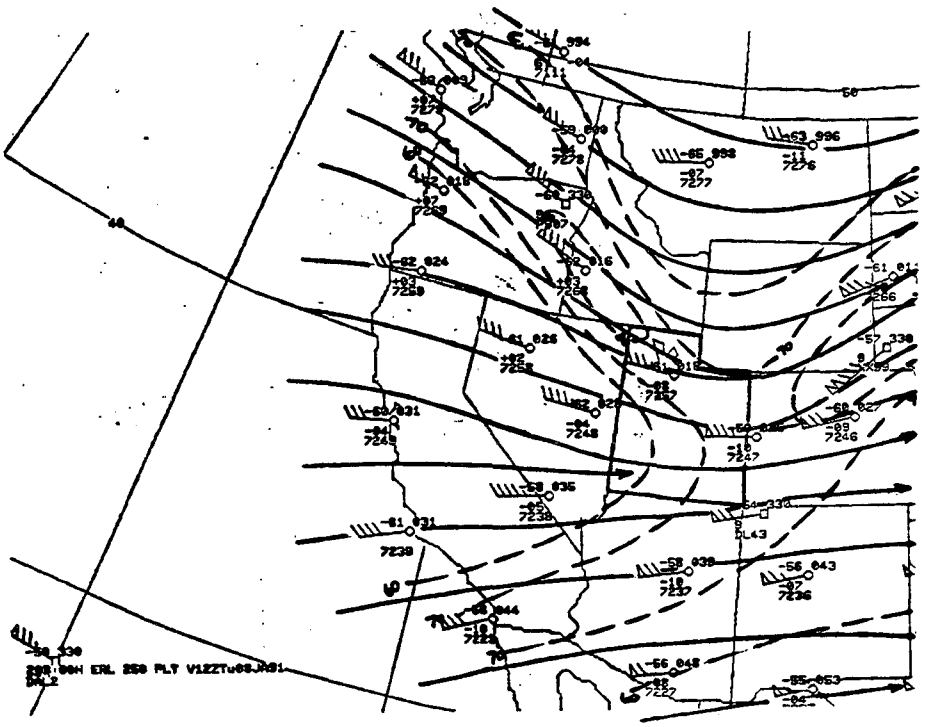


FIG 3b. 250 mb hts (solid) and isotachs (dashed) for 12z 8 Jan 1991

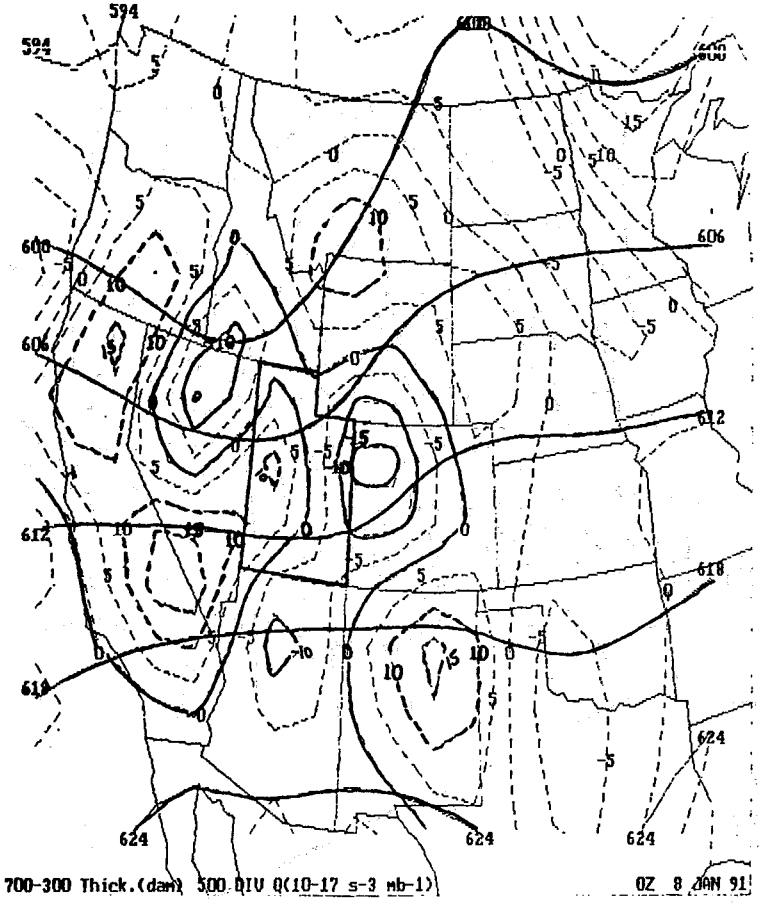


FIG 4. 700-300 mb Thickness (solid) and 500 mb DIV Q (dashed)

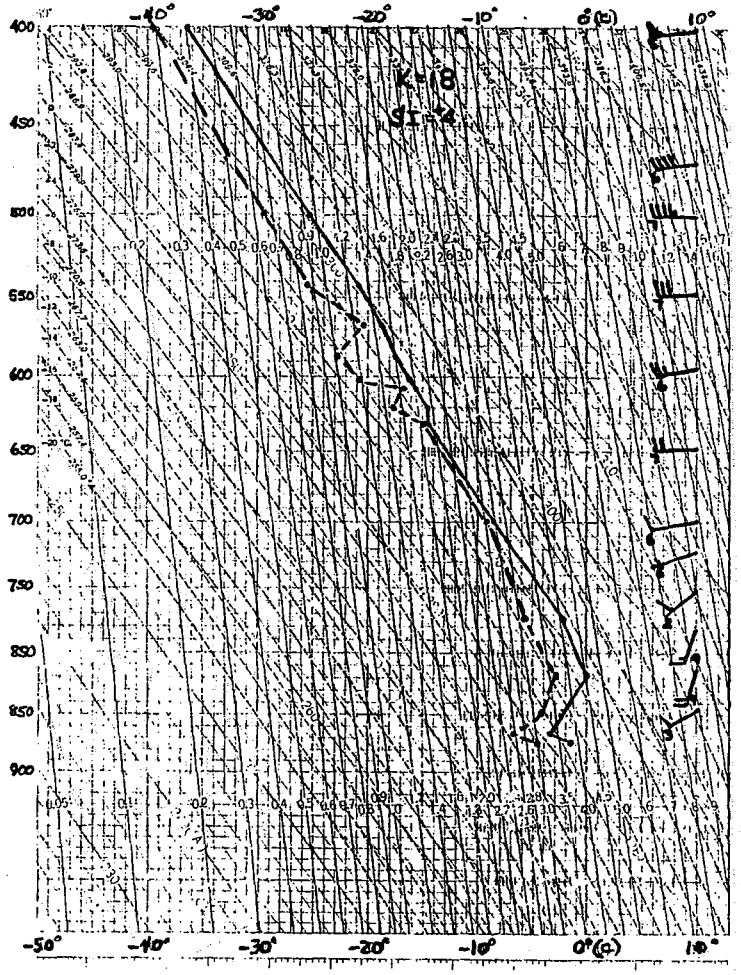


FIG 5. 00Z 8 January 1991 SLC sounding

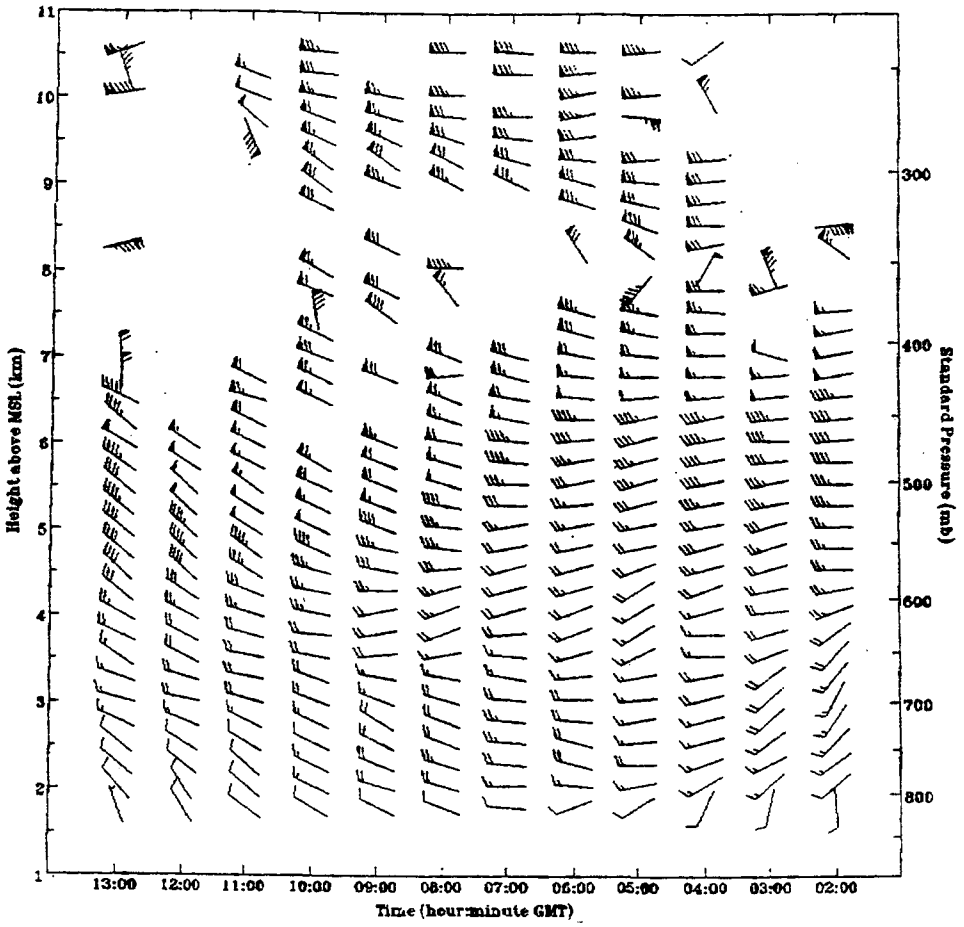


FIG 6. Dugway (DPG) Wind Profiler
data for 02Z-13Z 8 Jan, 1991