1. INTRODUCTION

The Intermountain Precipitation Experiment (IPEX) is a field and research program designed to improve the understanding, analysis, and prediction of precipitation in complex terrain, with an emphasis on the Intermountain West of the United States (Schultz et al. 2002). This paper presents an analysis of the third intensive observing period (IOP3), which examined a winter storm that produced up to 90 cm of snow in the Wasatch Mountains from 0600 UTC 12 Feb - 0600 UTC 13 Feb 2000. During the event, heavy snow accumulations resulted in an avalanche that briefly dammed the Provo River, and avalanche hazard prompted the closure of Little Cottonwood Canyon, where more than 200 day visitors were forced to stay overnight at Alta and Snowbird ski areas.

2. OBSERVATIONAL ANALYSIS

IOP3 featured the passage of a mid-level (700–500 hPa) trough followed 3 h later by a surface trough (not shown). Crest-level winds prior to and during passage of the mid-level trough were southwesterly to westerly and oriented roughly normal to the Wasatch Mountains where substantial orographic precipitation enhancement was observed (Fig. 1). Although precipitation generally increased with elevation, there were some important exceptions. First, near Ogden (OGD), precipitation was enhanced in the lowlands upstream of the Wasatch Mountains. Second, over the Salt Lake Valley, precipitation shadowing by the Oquirrh Mountains resulted in lower precipitation amounts. Finally, although several precipitation maxima were observed along the Wasatch crest, by far the largest precipitation amounts (74 mm liquid equivalent) were observed near the summit of Ben Lomond Peak (BLP).

Figures 2 and 3 summarize the mesoscale and radar structure of IOP3 at ~1800 UTC 12 Feb 2000. At this time, the mid-level trough was located over the Great Salt Lake and southwesterly large-scale flow with a Froude number of ~0.75 impinged on the Wasatch Mountains. Low-level confluence was observed between this southwesterly flow and terrain-parallel southerly flow within about 30 km of the Wasatch Mountains (Fig. 2). Analysis of gridded surface analyses of this event revealed that the conflu-

Figure 1. IOP3 Storm-total precipitation (liquid equivalent, contours every 10 mm) from 06 UTC 12 Feb – 06 UTC 13 Feb 2000. Accumulation at selected sites annotated. Reprinted with permission from Cheng (2001).

Figure 2. Surface streamlines at 1800 UTC 12 Feb.

Figure 3. Radar cross-section along line AB of Fig. 1.

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ence zone was also convergent and thus is termed a conver-
gence zone. Radar imagery from the NOAA P-3 tail-
Doppler radar, collected from 1817–1835 UTC, showed
an impressive “reflectivity wall” just east of the conver-
gence zone, roughly 20 km upstream of the Wasatch,
with higher reflectivities to the east (Fig. 3). A narrow
reflectivity maximum was also observed directly over the
Wasatch Mountains where the greatest precipitation
rates were observed. High reflectivities near the surface
upwind of the Wasatch represent the bright band.

Figures 4 and 5 illustrate the near-barrier kinematic
structure at 1832 UTC 12 Feb based on data collected by
two University of Oklahoma Doppler on Wheels (DOW)
X-band radars (Wurman et al. 1997). At mid-mountain
level, southwesterly flow was observed (Fig. 4). Analysis
of the upslope component of the horizontal wind at this
level suggests that upward motion reached ~2 m s−1 near
the Wasatch Mountains (not shown). In addition, the
southwesterly flow was oriented nearly perpendicular to
the Ben Lomond ridge line, which observed the greatest
precipitation during this event. Strong up-canyon flow
was found in Ogden and Weber canyons, suggesting that
the Wasatch act as a “leaky barrier” during this event. Fig.
5a reveals that a shallow terrain-parallel wind maximum
was located at or just above the surface near the
Wasatch Mountains (Fig. 5a). Above this maximum, the
terrain-parallel wind component decreased to near zero
just above crest level. In contrast, the cross-barrier wind
component increased with height, reaching a maximum
of 12 m s−1 just above crest level (Fig. 5b).

3. SUMMARY

Data collected during IPEX IOP3 illustrates the
important role of terrain-induced circulations in determi-
ning the distribution of precipitation over northern Utah.
The development of a low-level convergence zone upwind of the initial Wasatch slope resulted in precipitation
enhancement over lowland regions, while mid-moun-
tain southwesterly flow impinging on the Wasatch
Mountains contributed to a narrow region of enhanced
precipitation directly over the barrier. The heaviest accumu-
lations were observed on Ben Lomond Peak, where the
local ridgeline was oriented normal to the mid-moun-
tain flow. Ongoing work is examining the precipitation
microphysics of the event, and using numerical simul-
tations to determine the processes responsible for produc-
ing the windward convergence zone.

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