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Title: MODEL SIMULATIONS OF THE INFLUENCE OF SYNOPTIC CONDITIONS ON VERTICAL MOTIONS IN THE SALT LAKE CITY REGION

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Model Simulations of the Influence of Synoptic Conditions on Vertical Motions in the Salt Lake City Region

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The Salt Lake City basin is one of a number of broad valleys in northern Utah. It was the location of the Vertical Transport and Mixing (VTMX) program field experiment in October of 2000, and it is an area that has experienced urban air quality problems within the basin. During this experiment, flow through the Jordan Narrows, the gap in the Traverse Range that divides the Salt Lake basin from the Utah basin to the south, was found to be significant, in addition to the known night time drainage from canyons that enter the valley from the east. In earlier studies, similar flow through a gap has been found to exist between the Tooele and Rush Valleys, just to the west. The earlier studies also indicated flows, through passes, between the Rush Valley and the valleys to its east.

This paper will present the results of numerical simulations of the Salt Lake City Basin and the surrounding region, including the Utah, Tooele, and Rush Valleys. The discussion will focus on how the circulations within the Salt Lake City basin are influenced by flows that enter or exit the basin from nearby canyons and basins. We will also investigate the role of synoptic weather conditions in this exchange.

Model Simulations of the Influence of Synoptic Conditions on Vertical Motions in the Salt Lake City Region

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NCAR/ATD (Dave Parsons and others)
Univ. of Utah Dept. of Meteorology Mesowest surface observations (John Horel and others)
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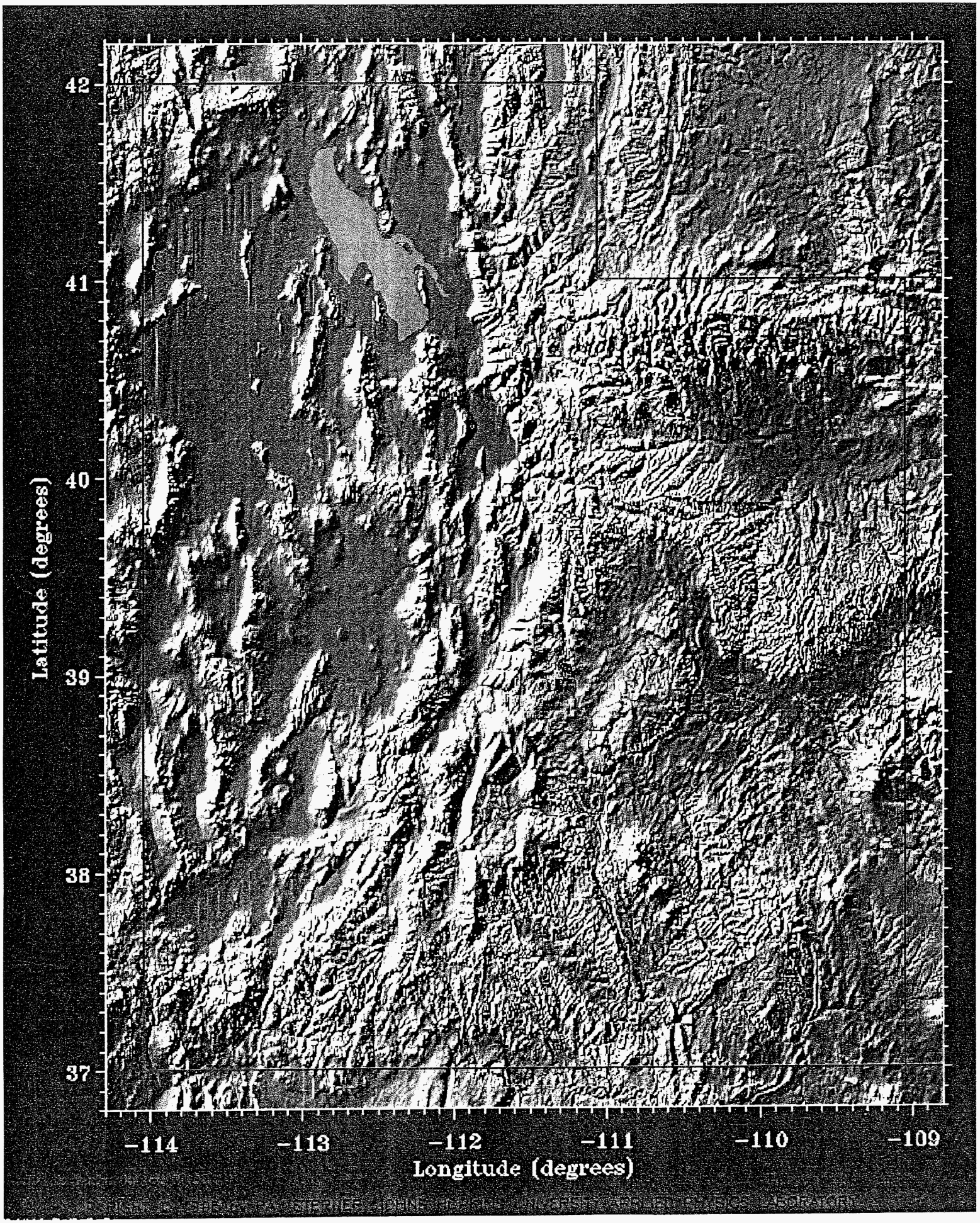
Questions

1. What is the nature of the interaction of terrain-induced flows with cold air in basins and with flows of different scales?
2. How are circulations and vertical mixing within the Salt Lake City basin influenced by flows that enter or exit the basin from nearby basins and by drainage flows from the canyons that enter the valley from the east?
3. How do synoptic scale weather patterns affect these interactions?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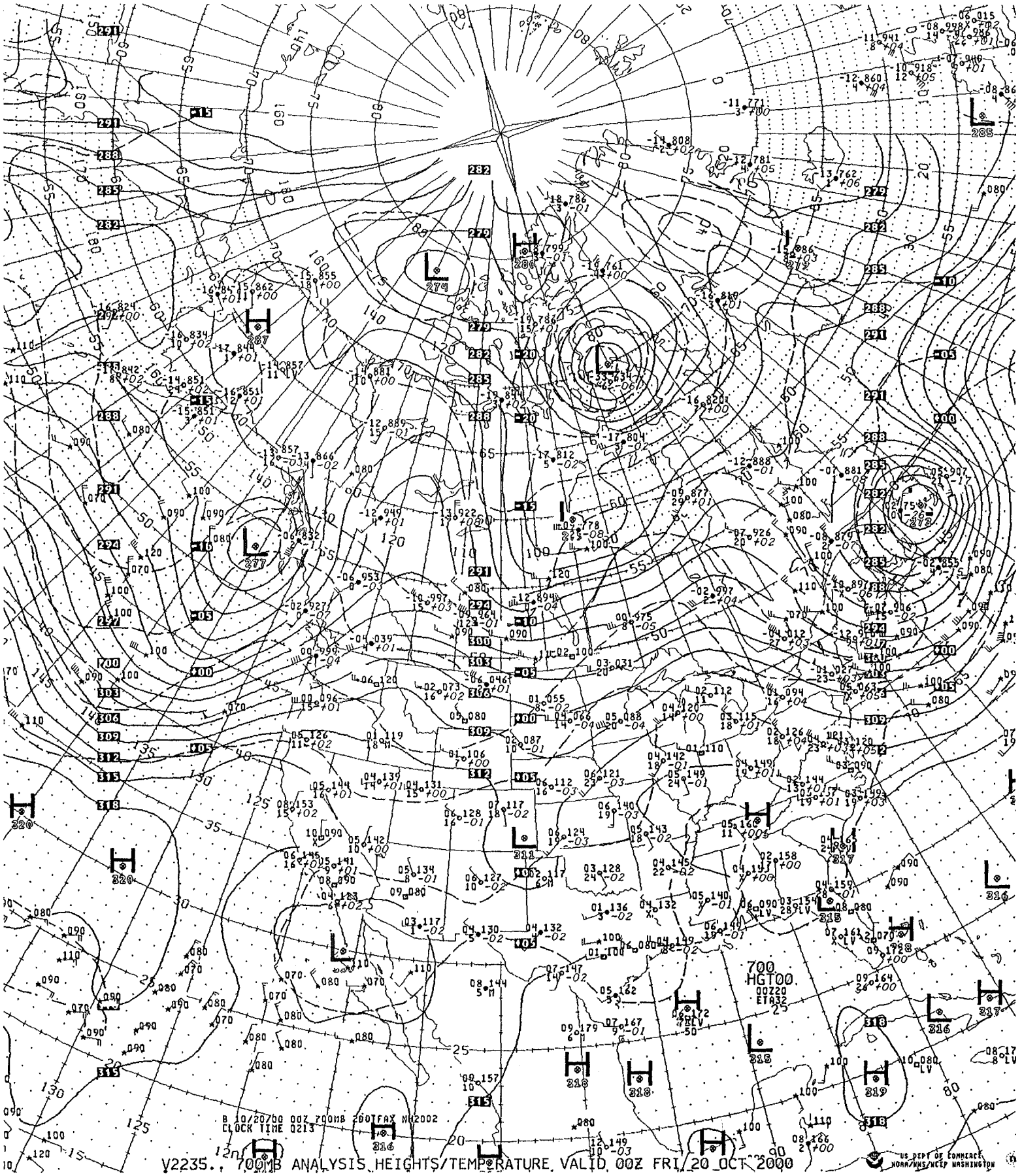
Longitude (degrees)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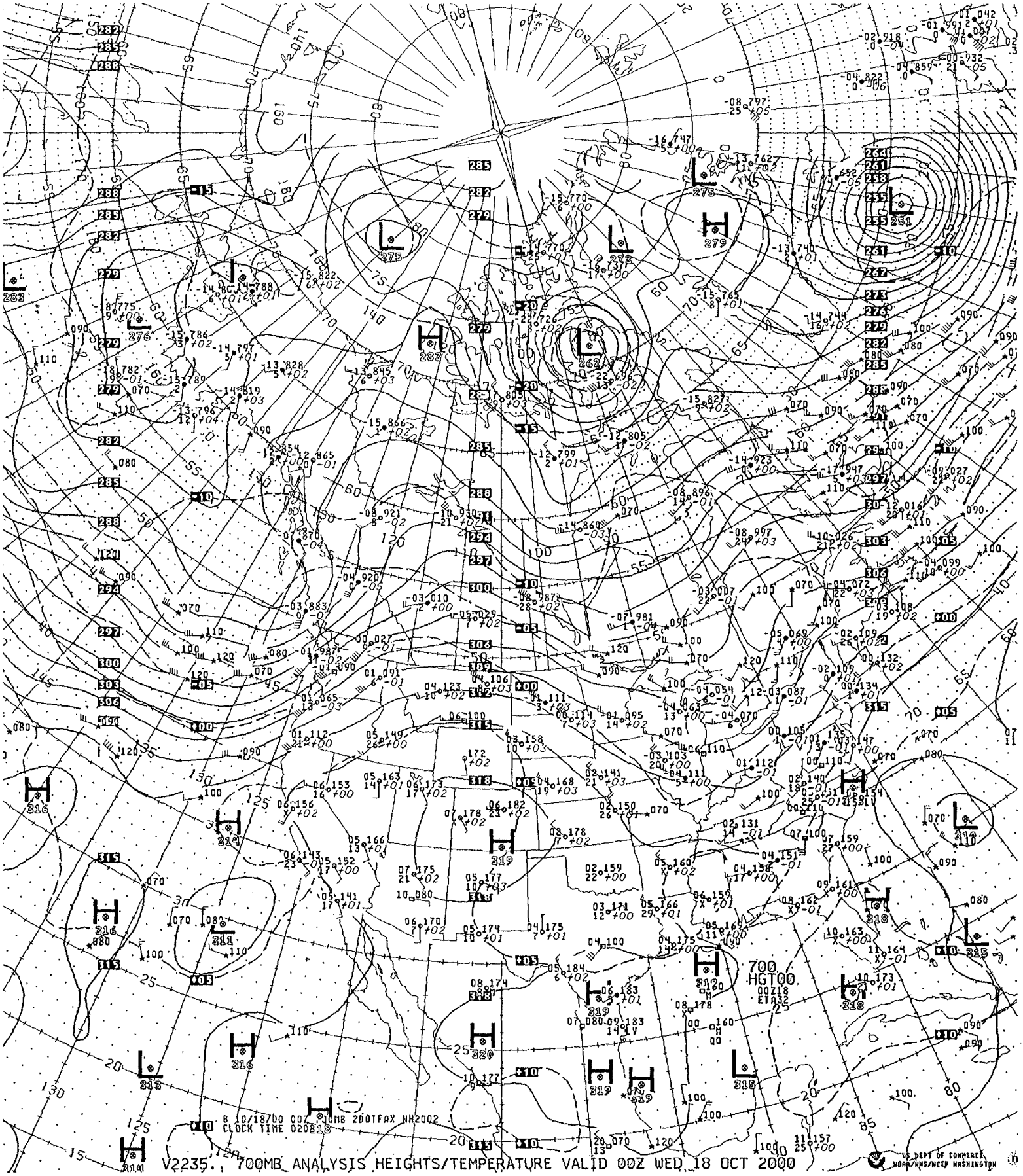
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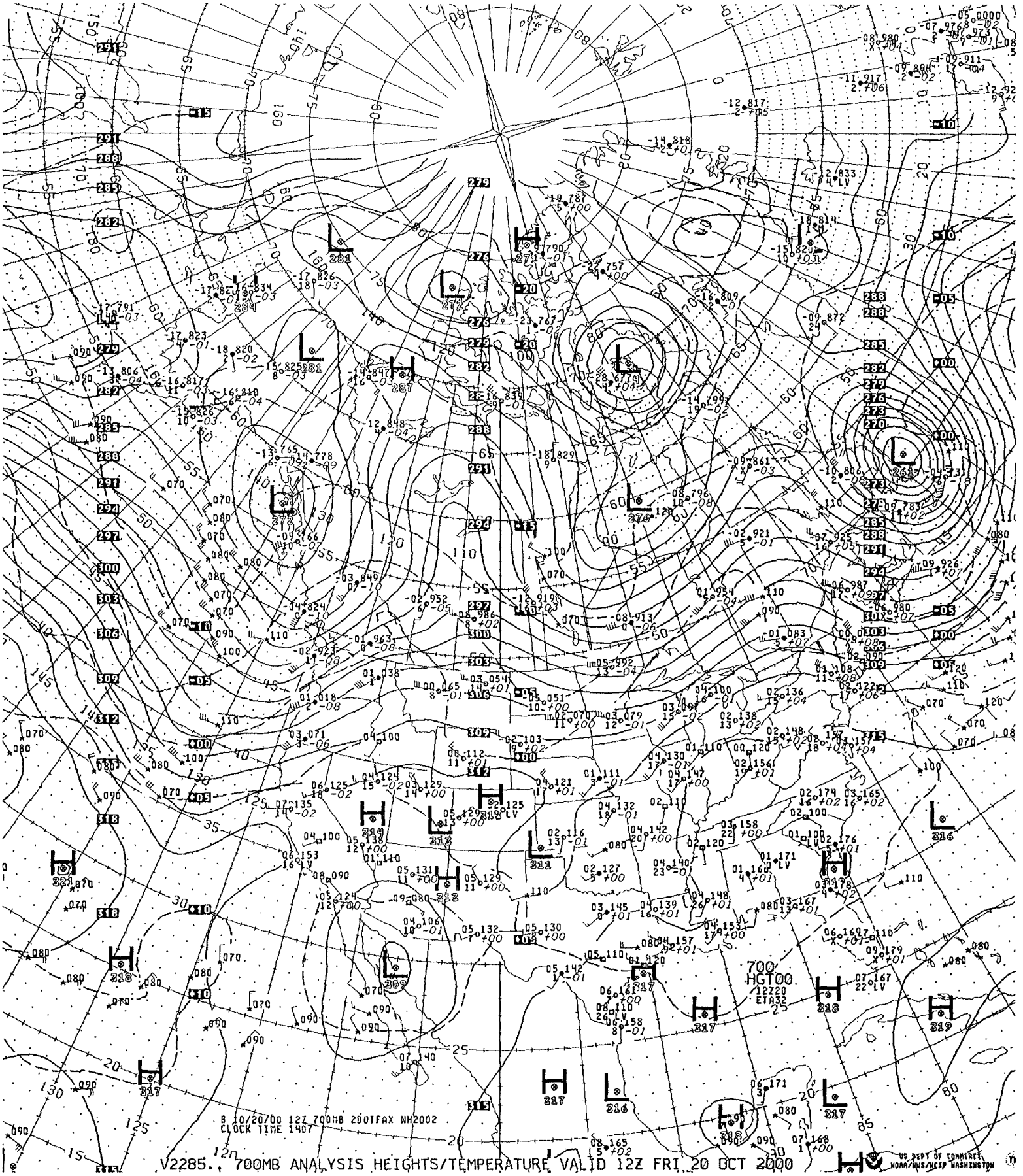
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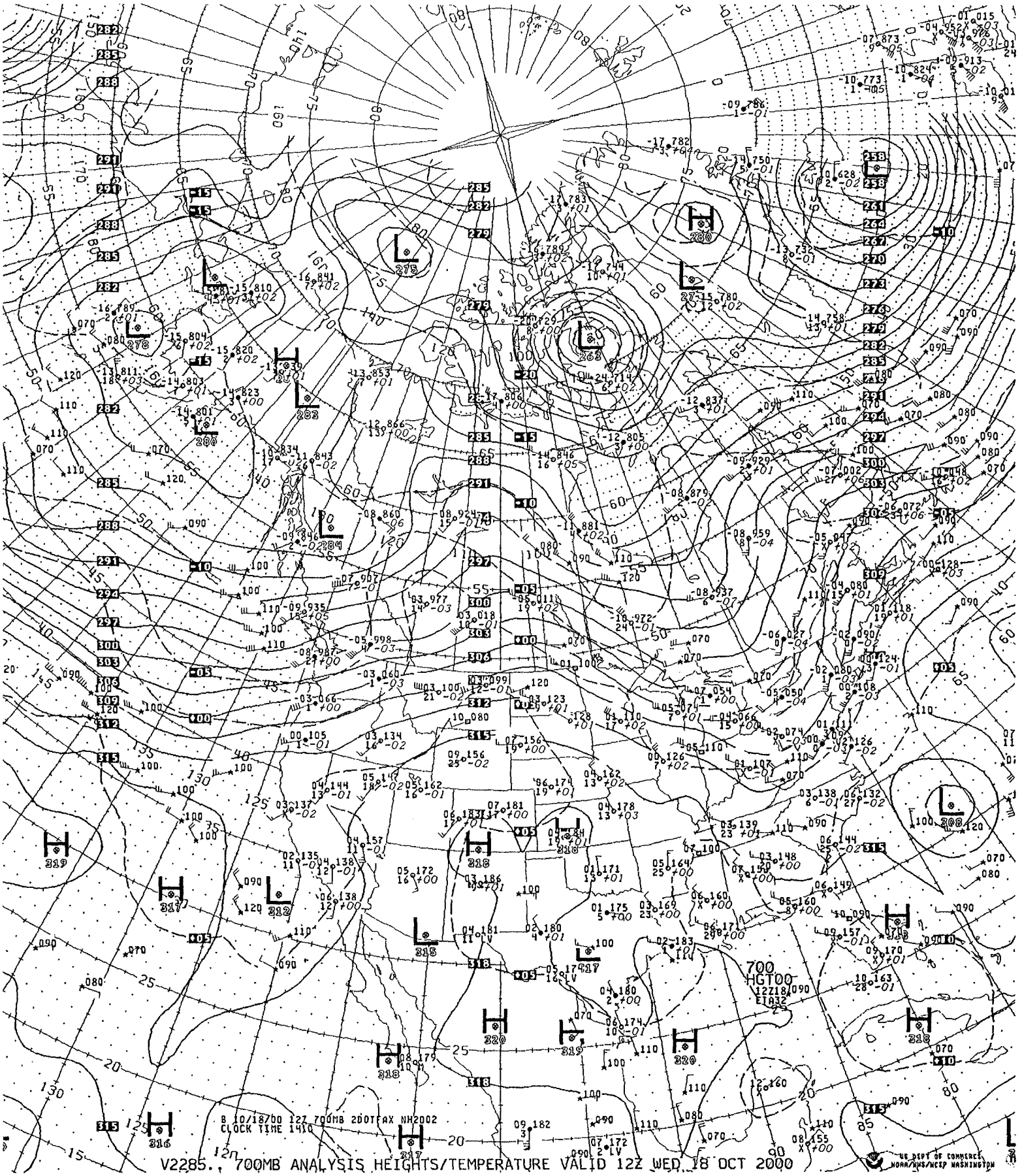
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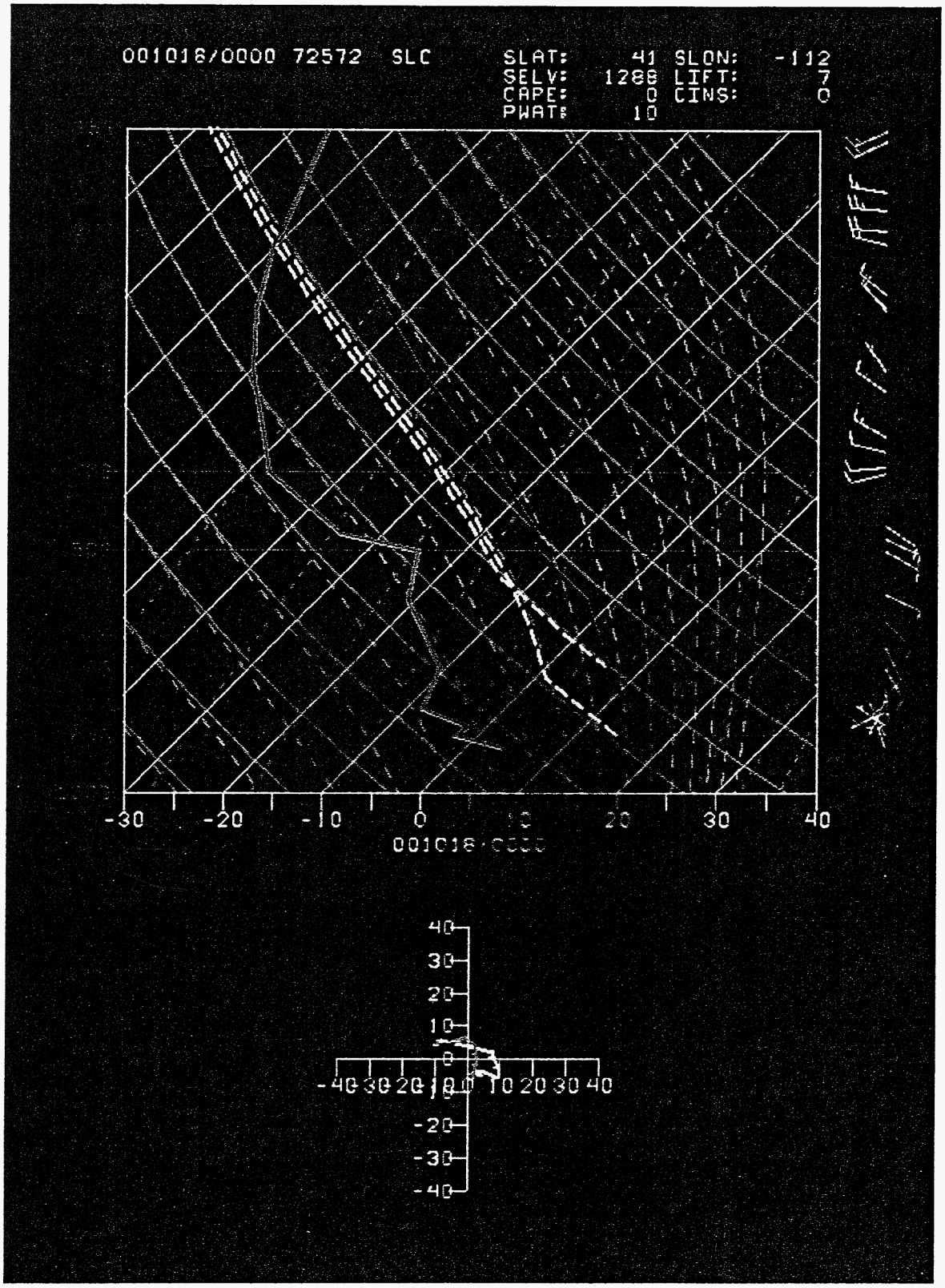
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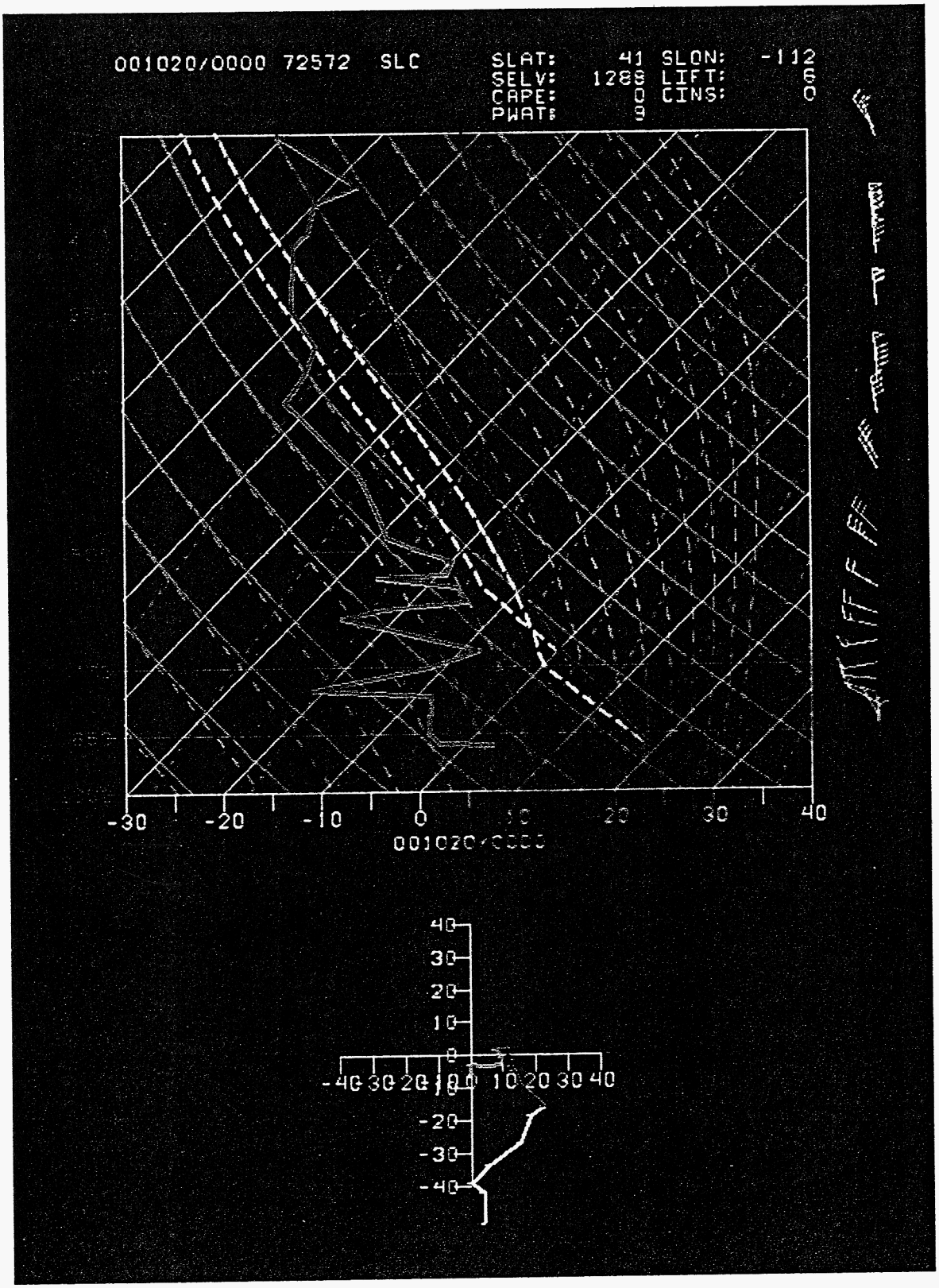
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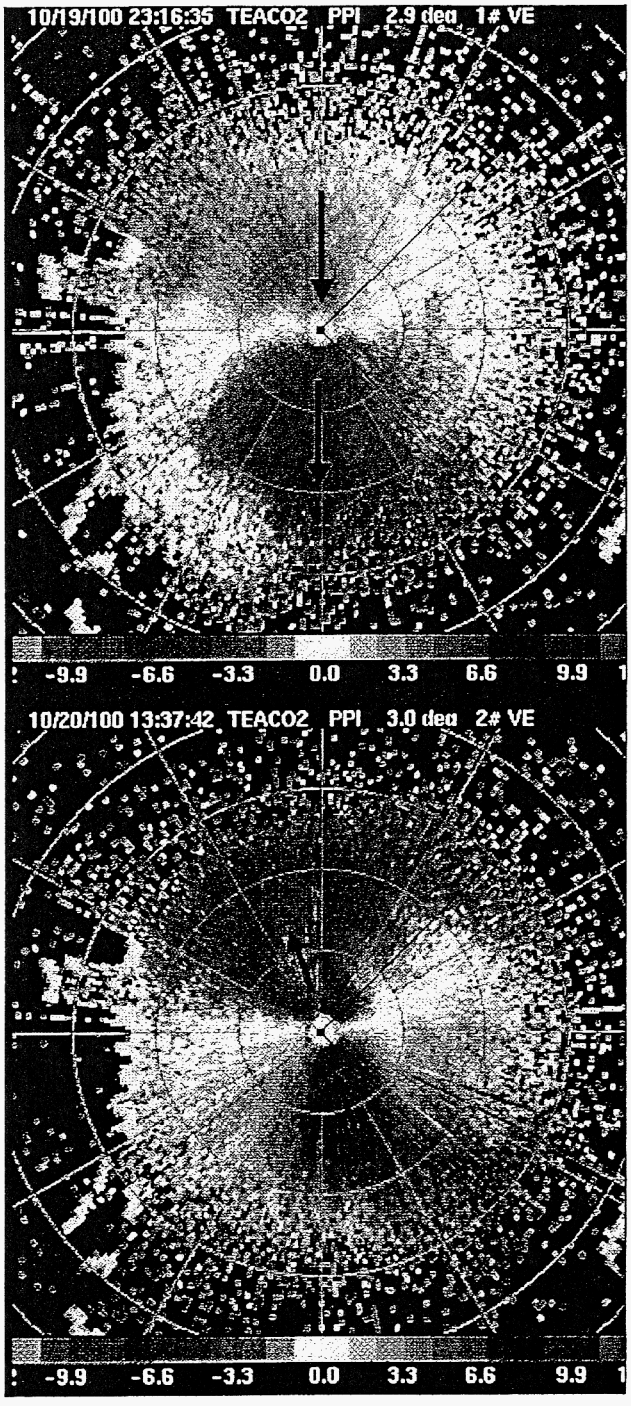
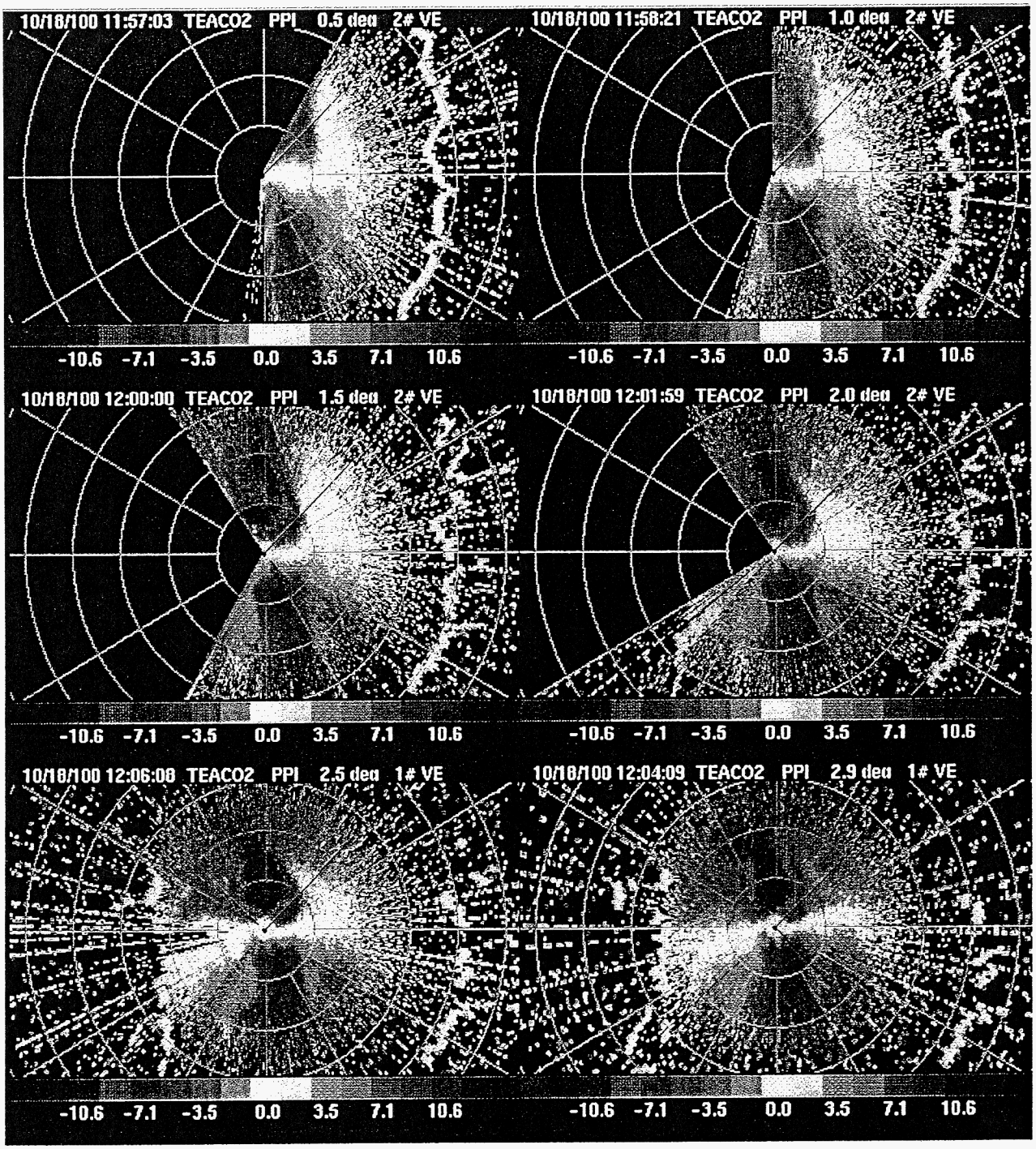


Courtesy of NOAA Environmental Technology Laboratory

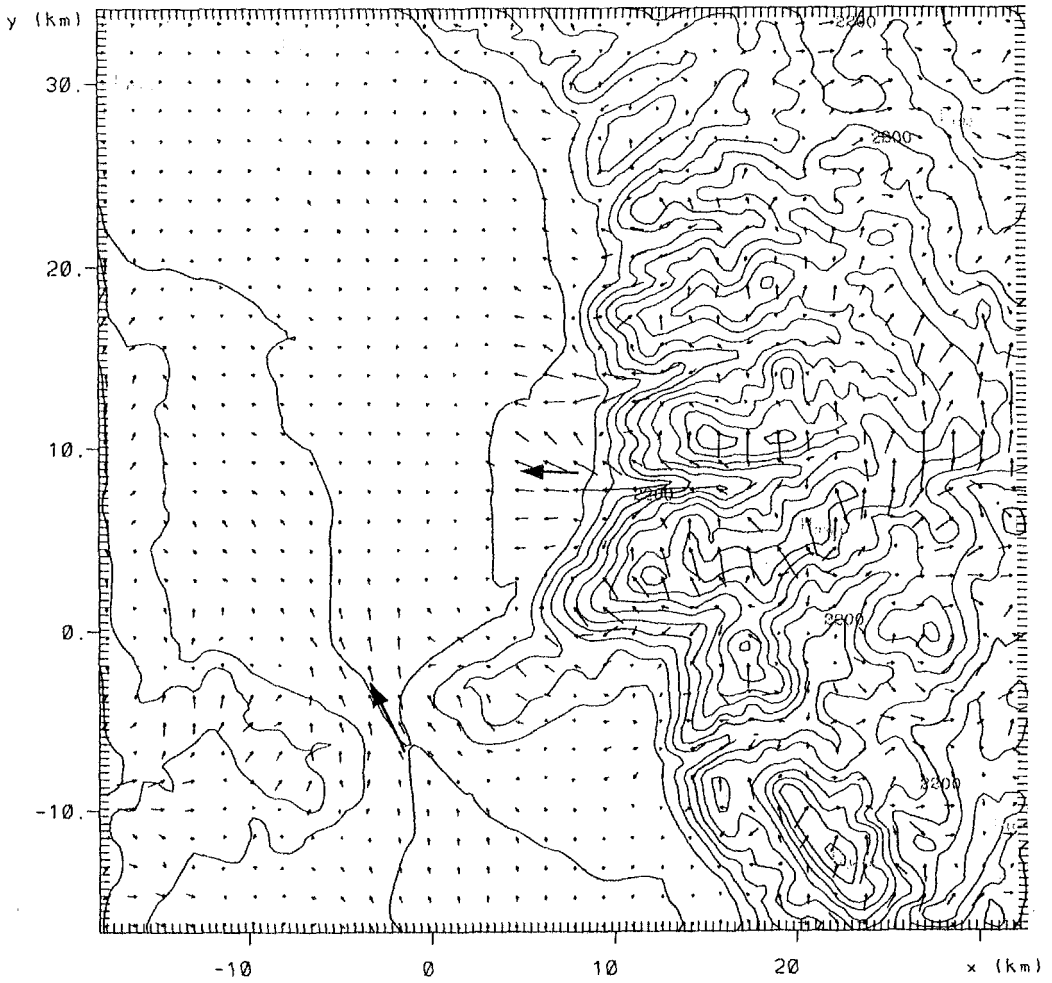


Courtesy of NOAA Environmental Technology Laboratory

RAMS simulations

- Employed three nested grids
  Grid 1 - 3.6 km grid spacing over northern Utah
  Grid 2 - 1.2 km grid spacing over 4 valleys of interest
  Grid 3 - 400 m grid spacing over SLC basin and northern Utah Lake basin
- 100 m vertical grid spacing on all grids
- Initialize with and weakly nudge to Reanalysis II observations
- Two runs starting at 0000 UTC, IOP 8 started on 19 October and IOP 7 started on 17 October

Grid 3 **0100 UTC 18 October**

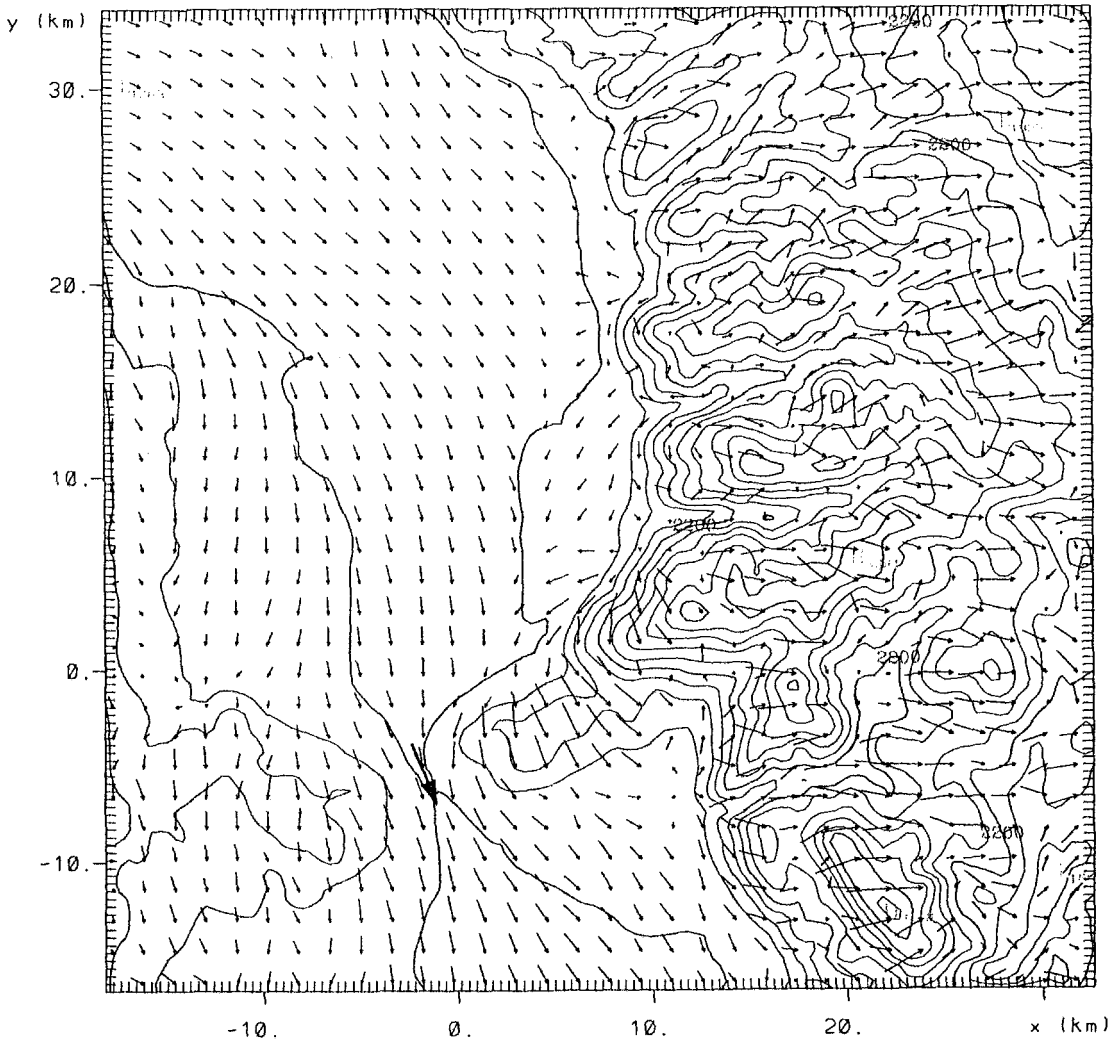


* 1 m s horiz

Max. 7.1

Grid 3

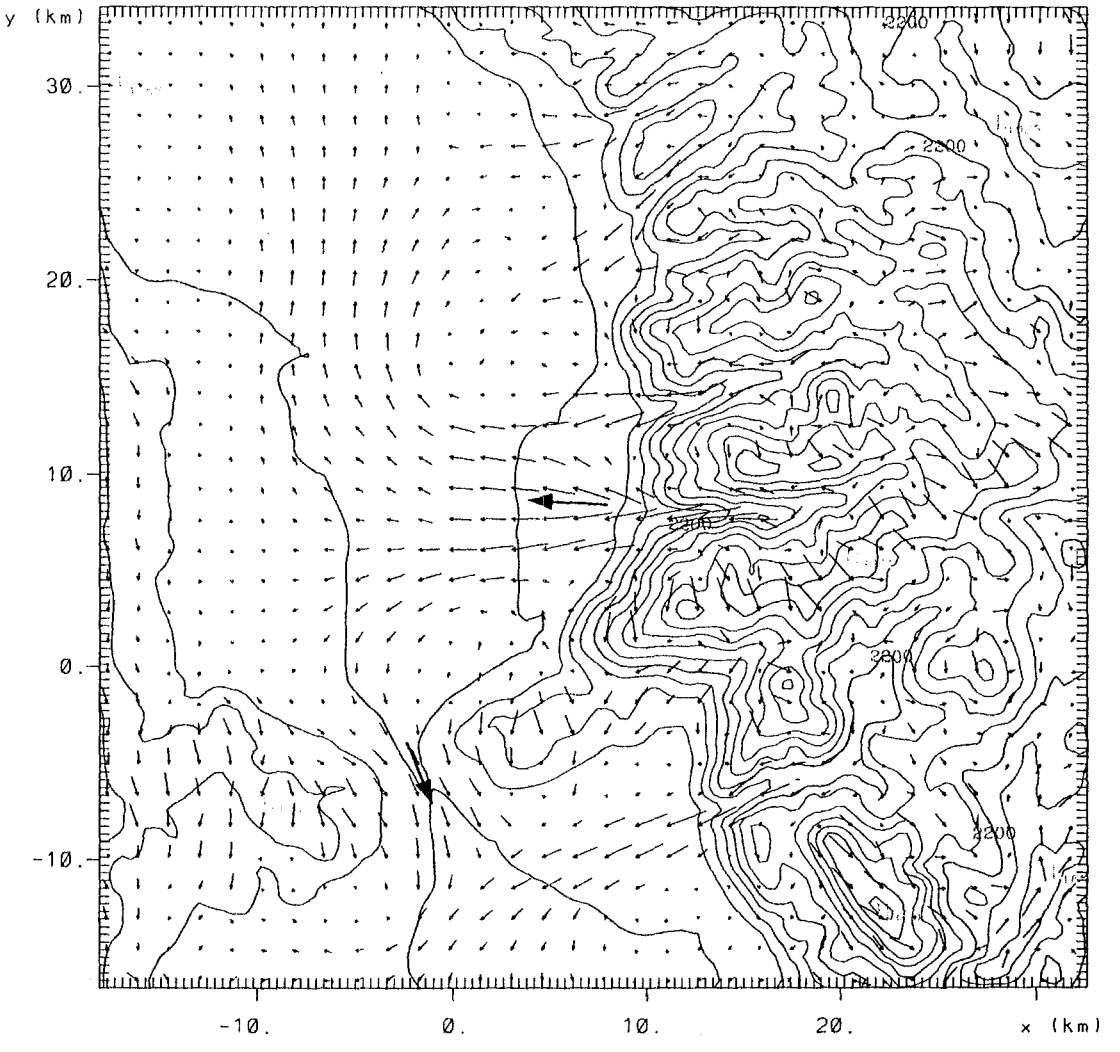
0100 UTC 20 October



→ 1 m s horiz

Max. 8.6

Grid 3 **0700 UTC 20 October**



→ 1 m s horiz

Max. 12.9

Grid 3

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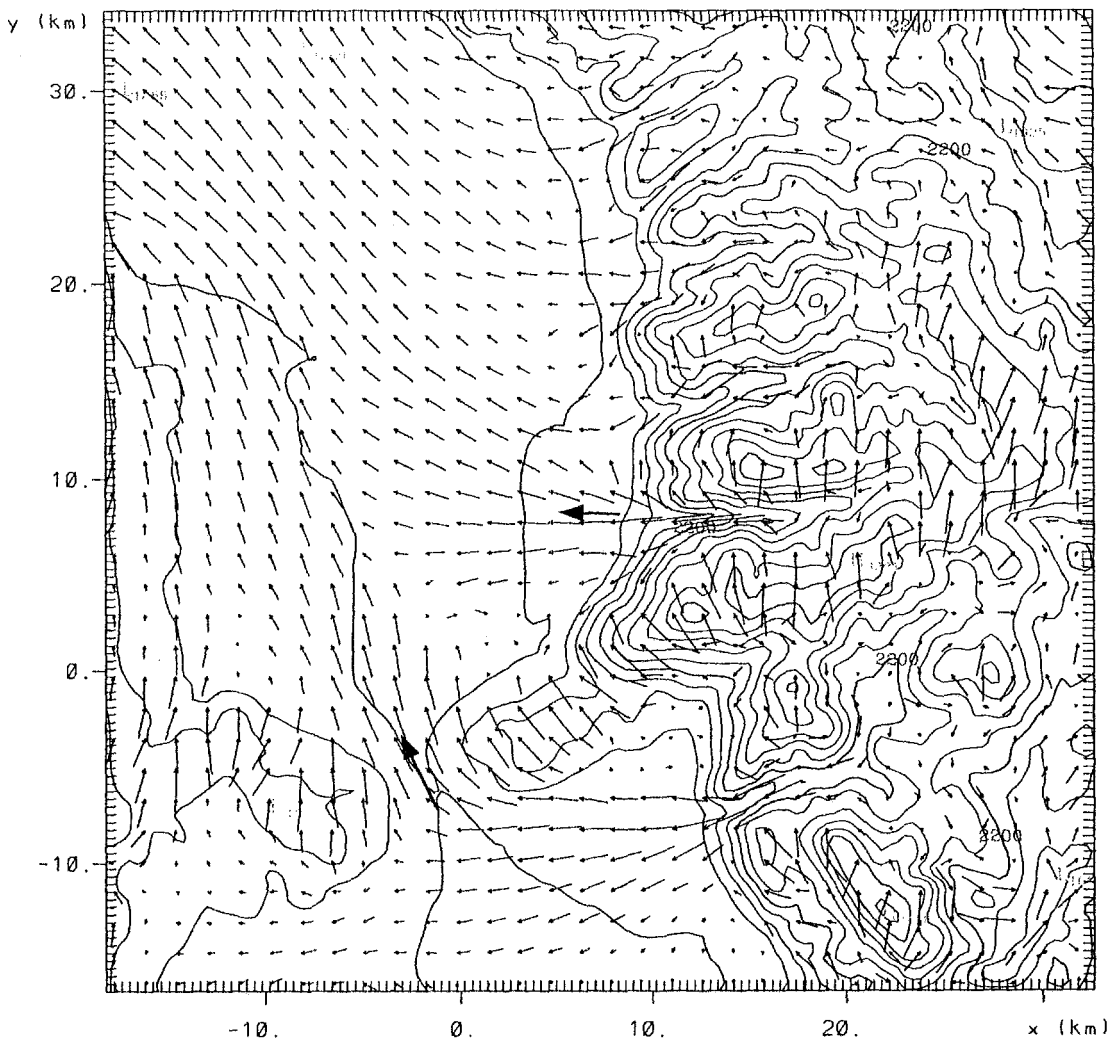

→ 1 m s horiz

Max. 11.8

Grid 3

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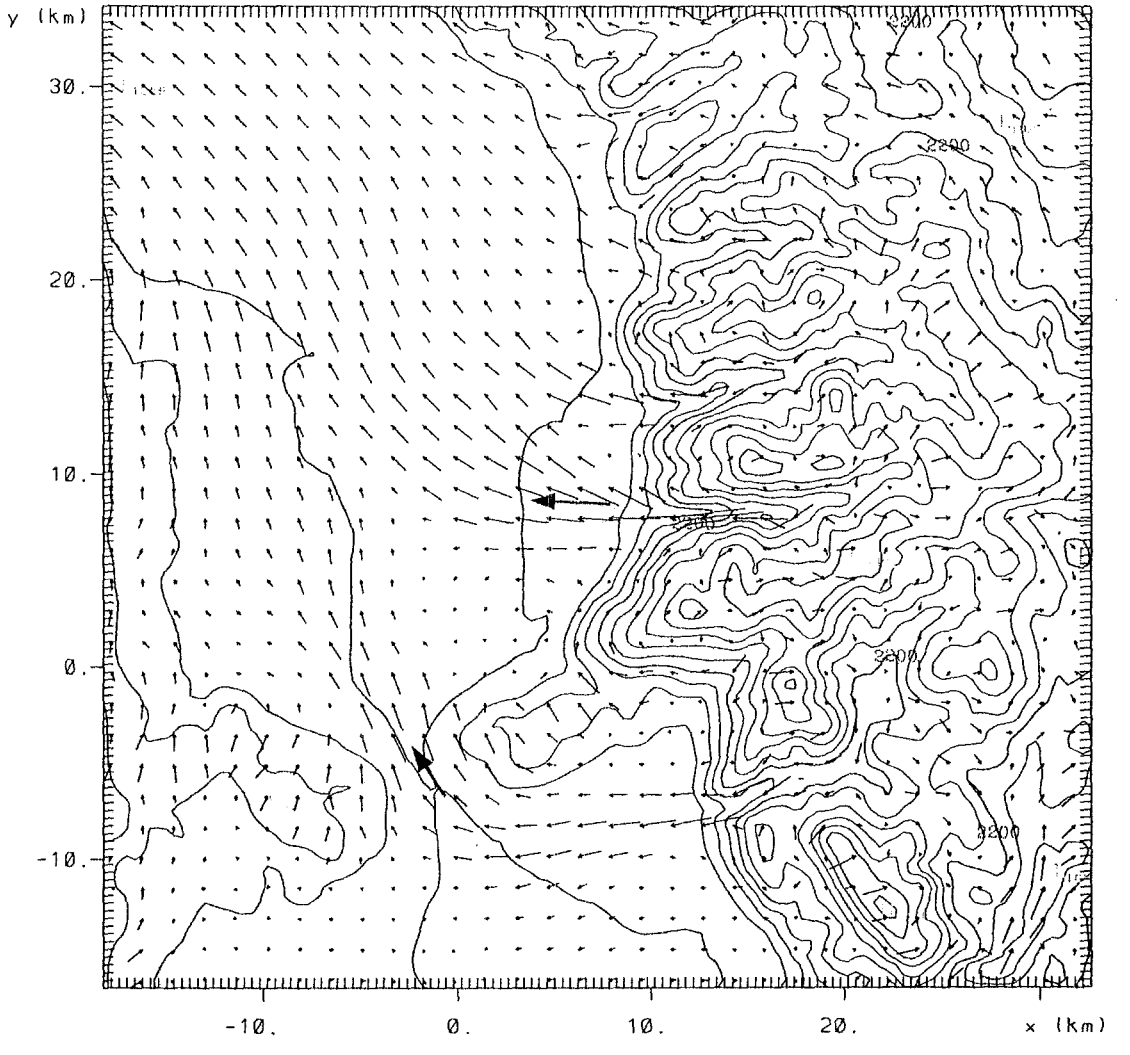
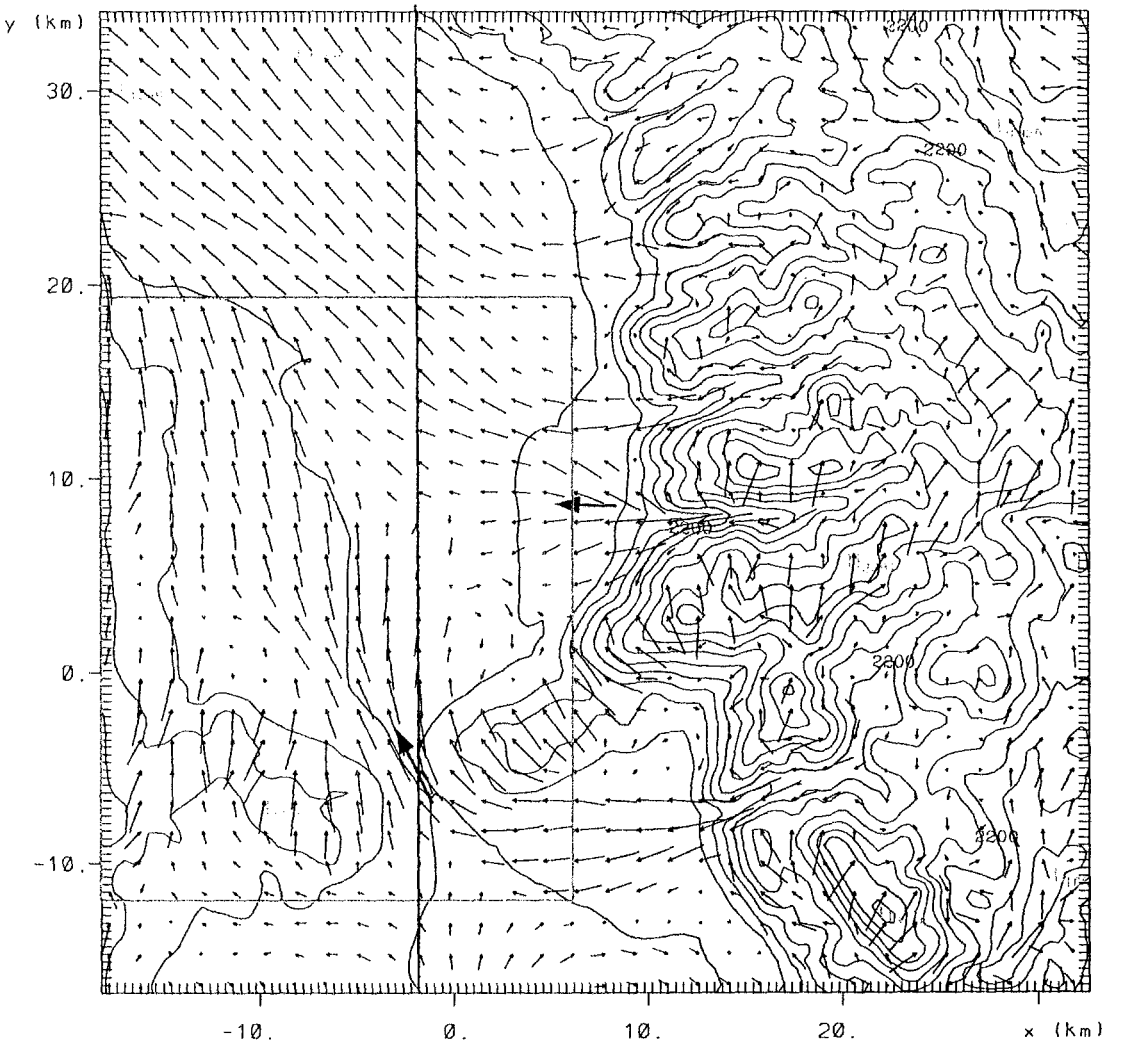


• 1 m s horiz

Max. 12.6

Grid 3

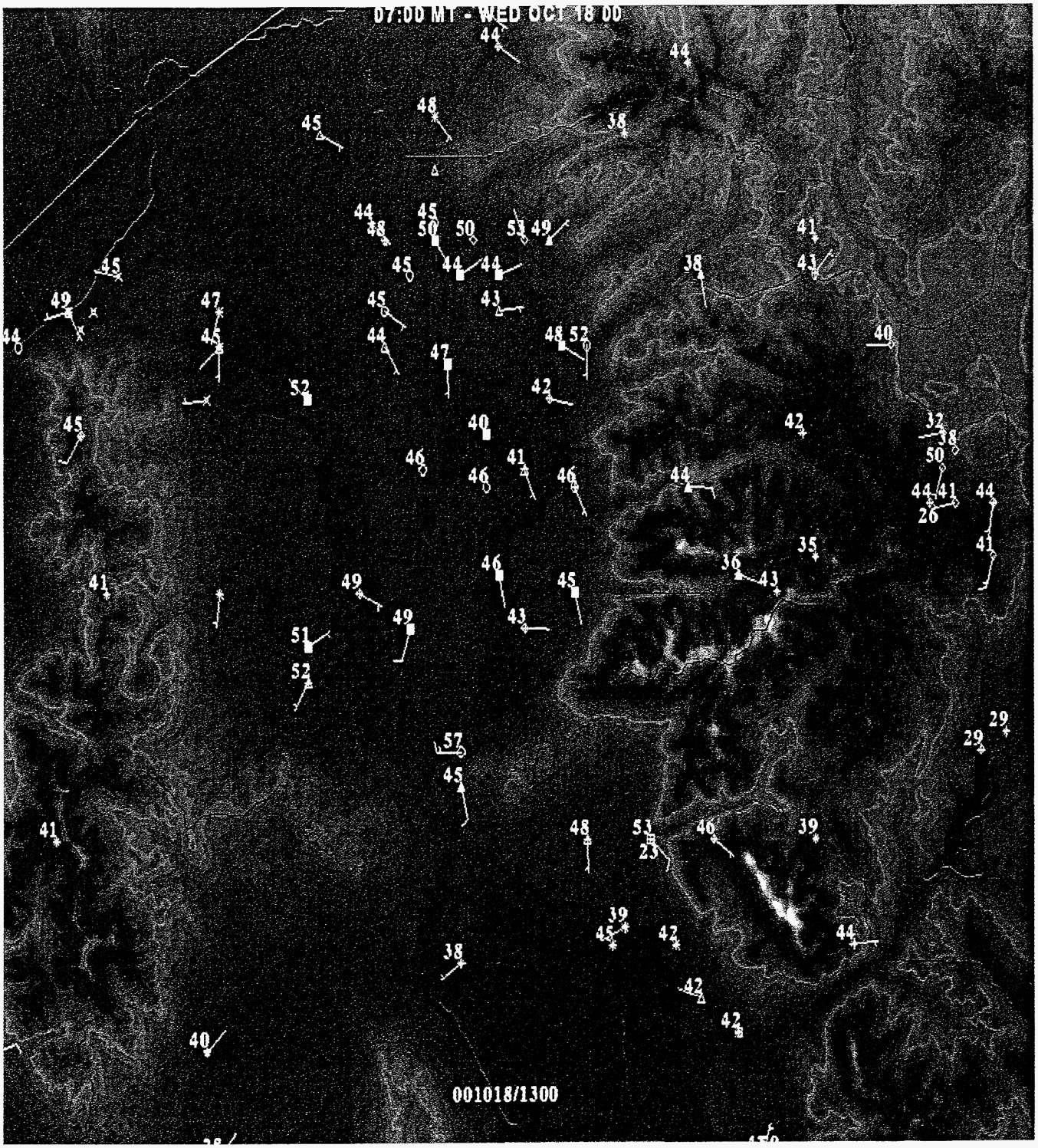
1300 UTC 18 October



• 1 m s horiz

Max. 12.5

Stronger winds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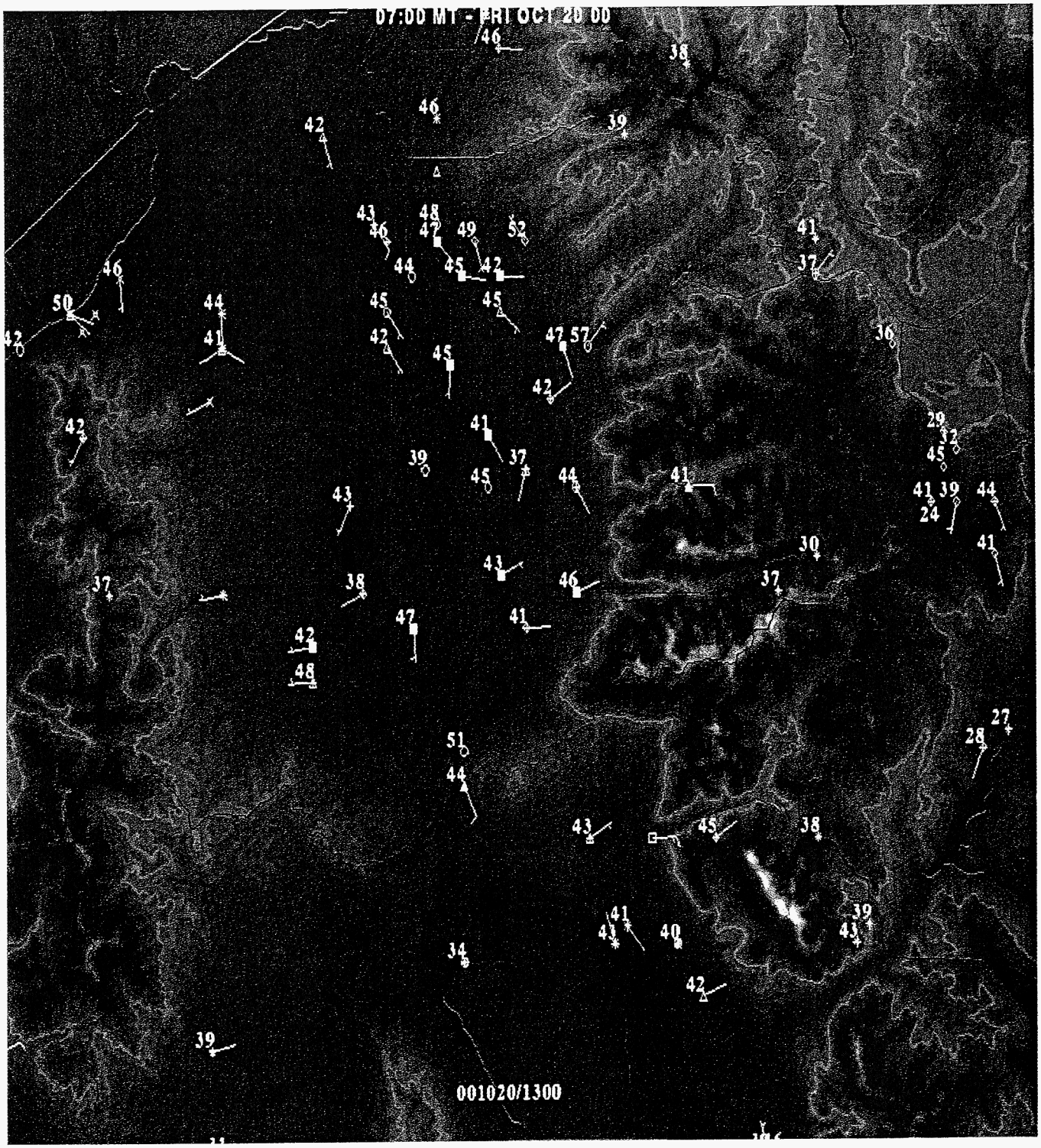
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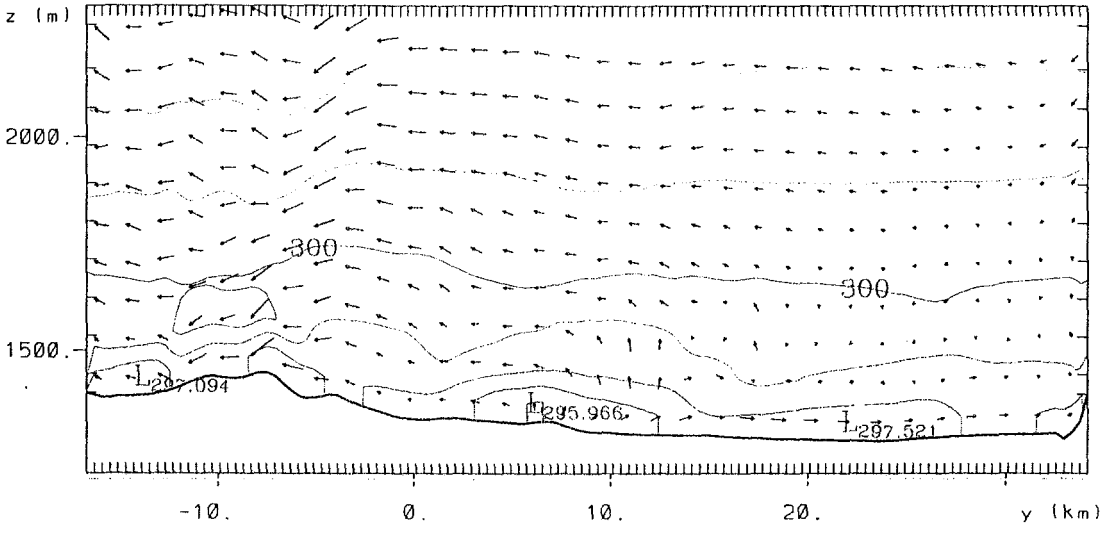
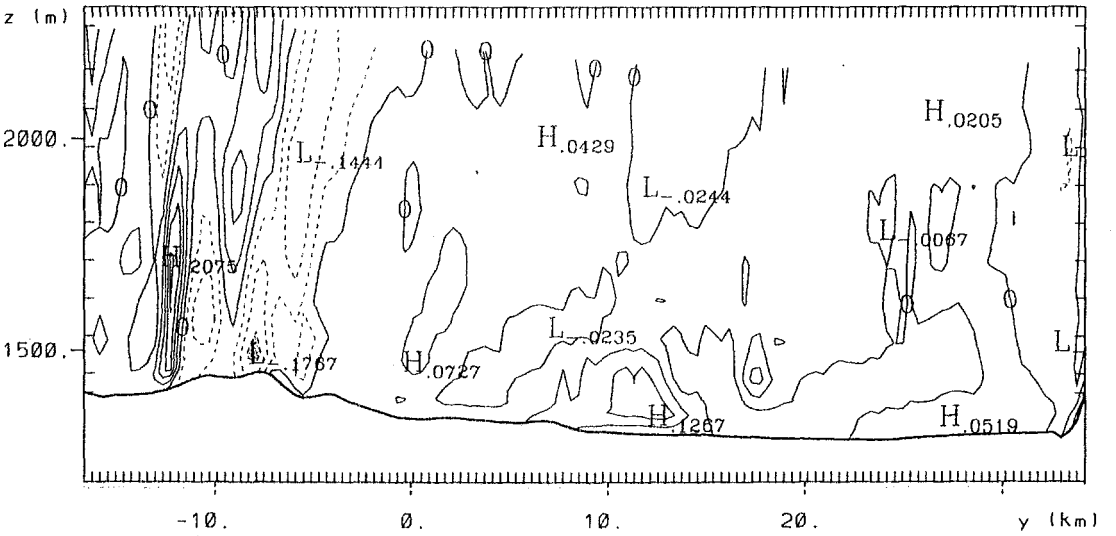


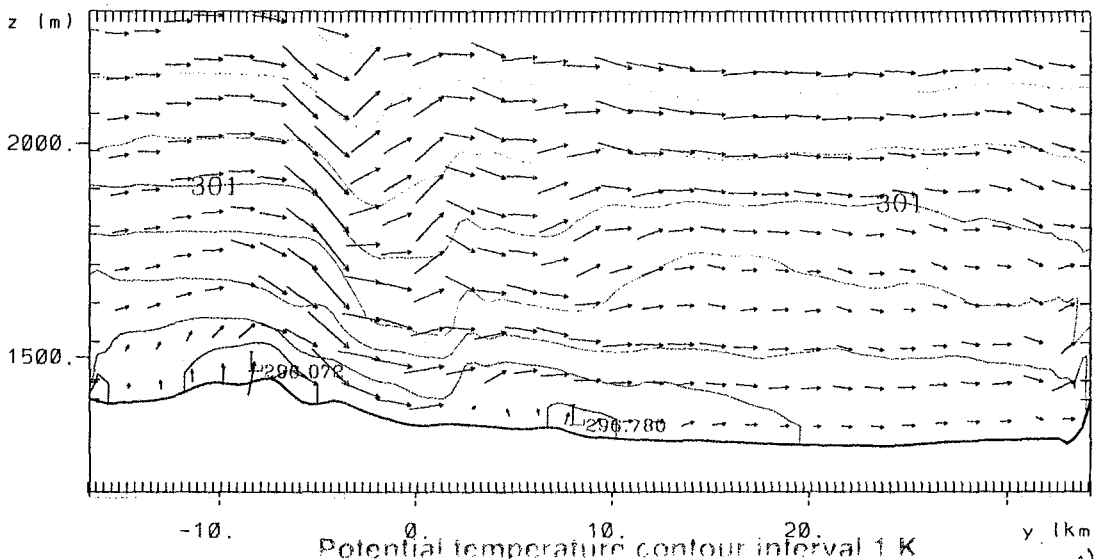
Potential temperature contour interval 1 K

Waves on S side of traverse



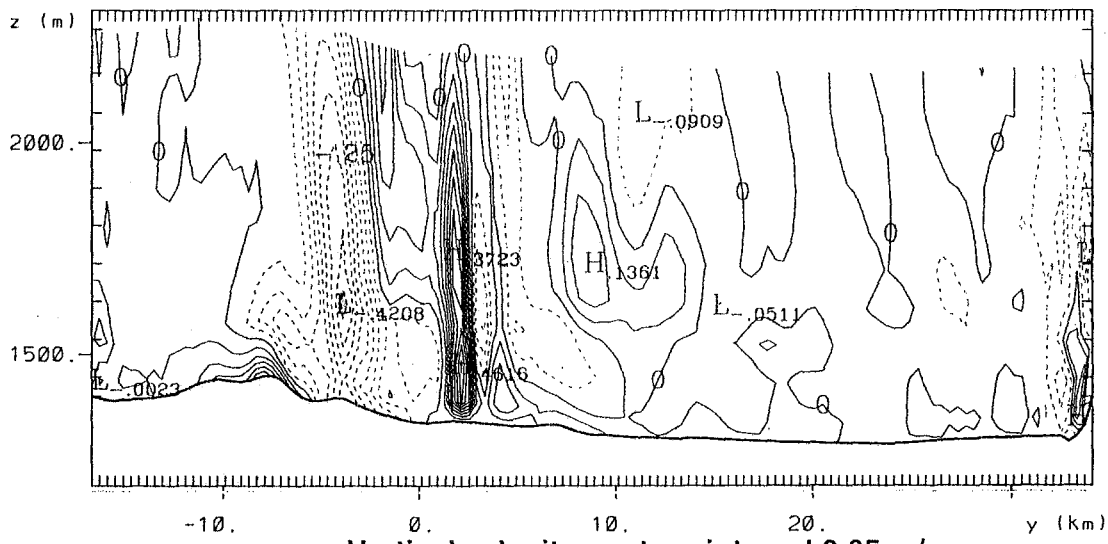
Vertical velocity contour interval 0.05 m/s

0700 UTC 18 October



Potential temperature contour interval 1 K

* Wave on N. side of trough
* interact w/ drainage
Higher amplitude
→ more instabilities
↓ Stronger winds



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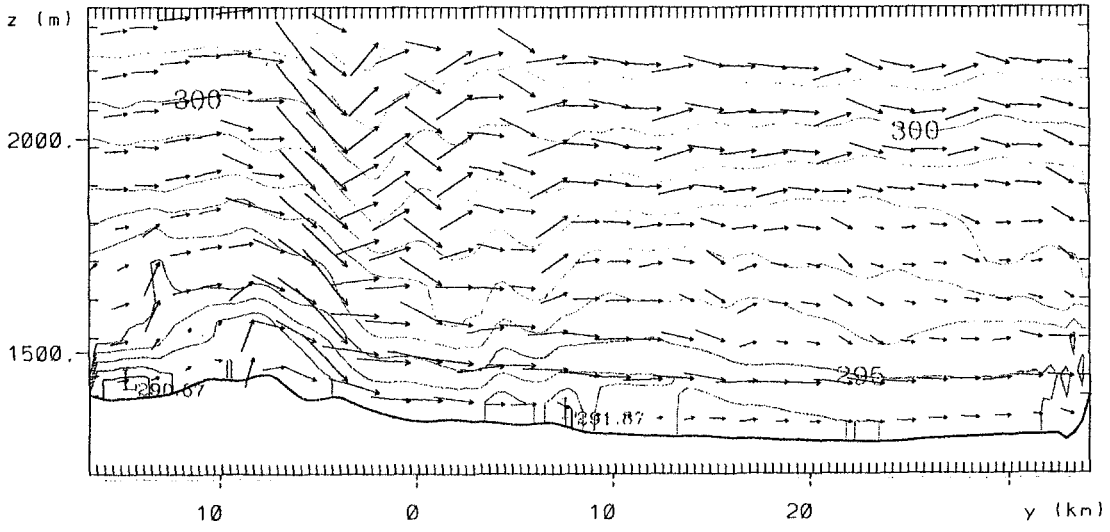

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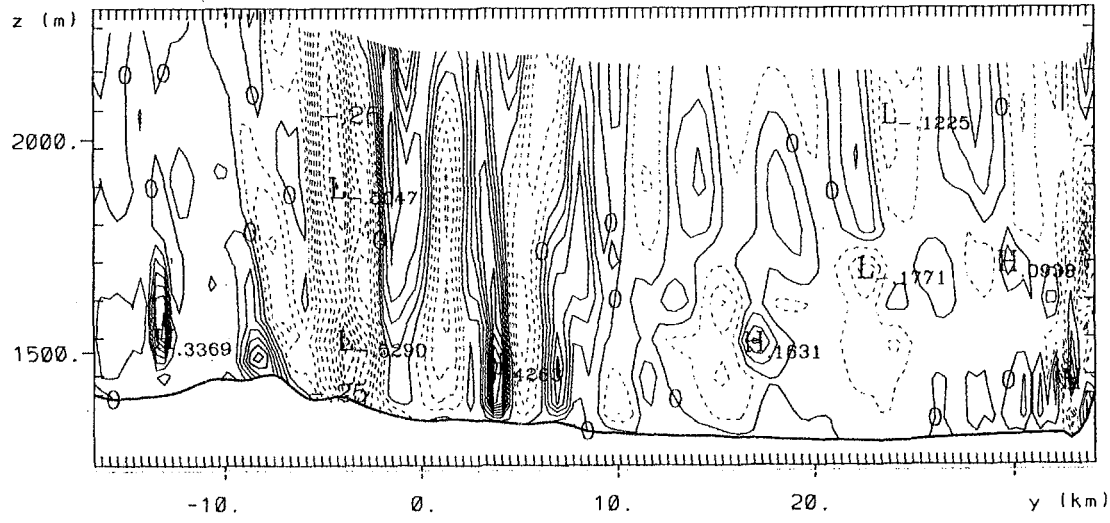

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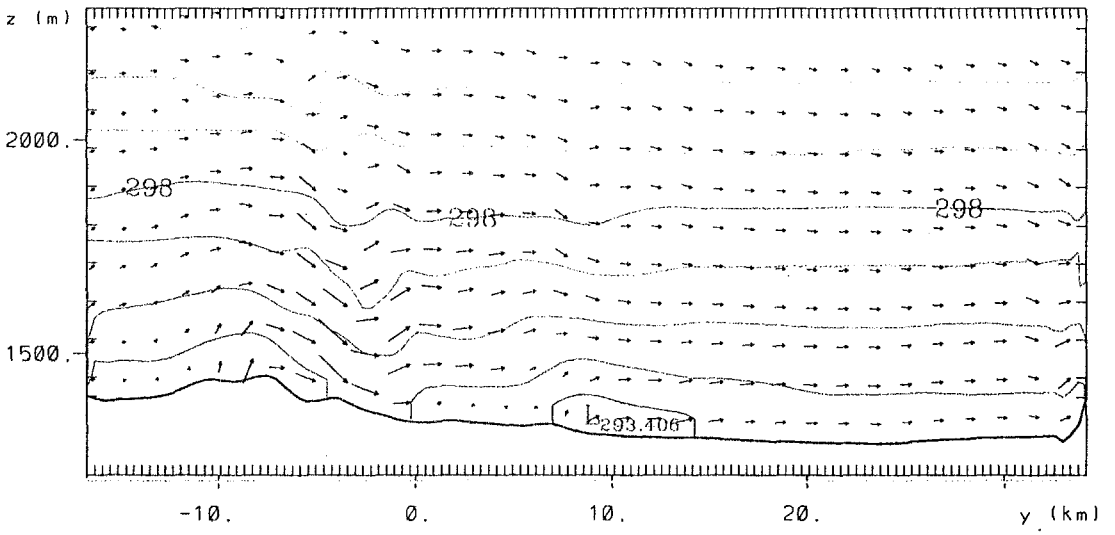
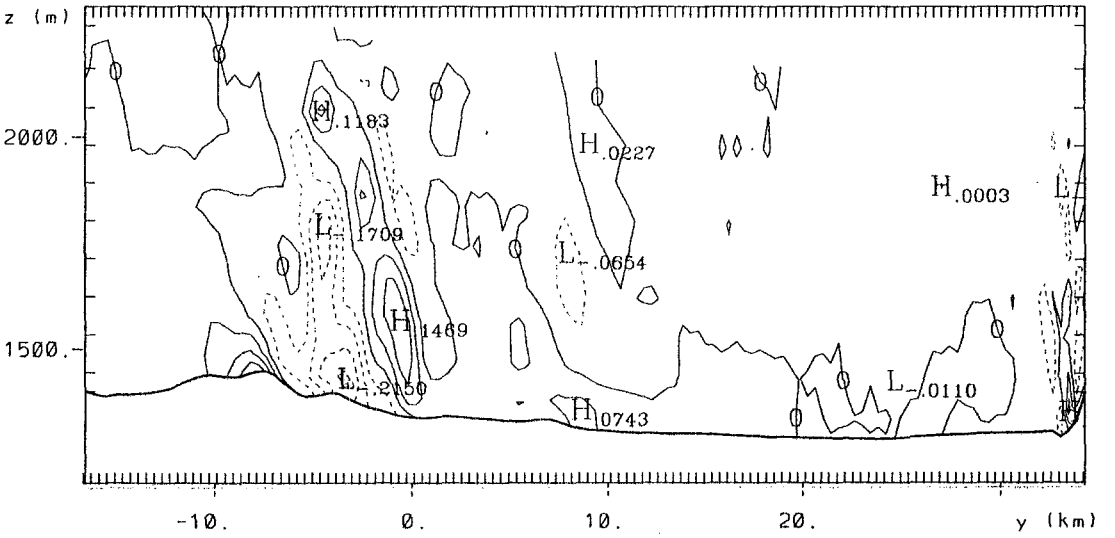


Potential temperature contour interval 1 K

similar but smaller amplitudes



Vertical velocity contour interval 0.05 m/s

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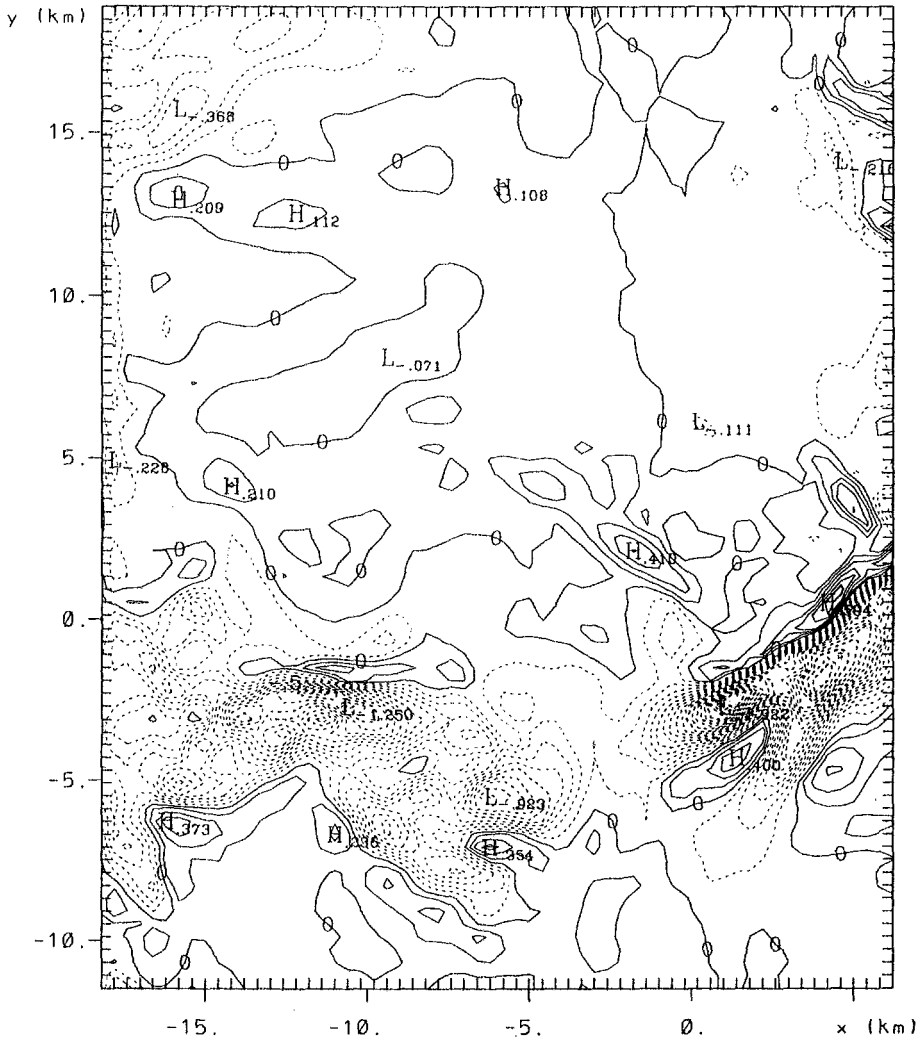
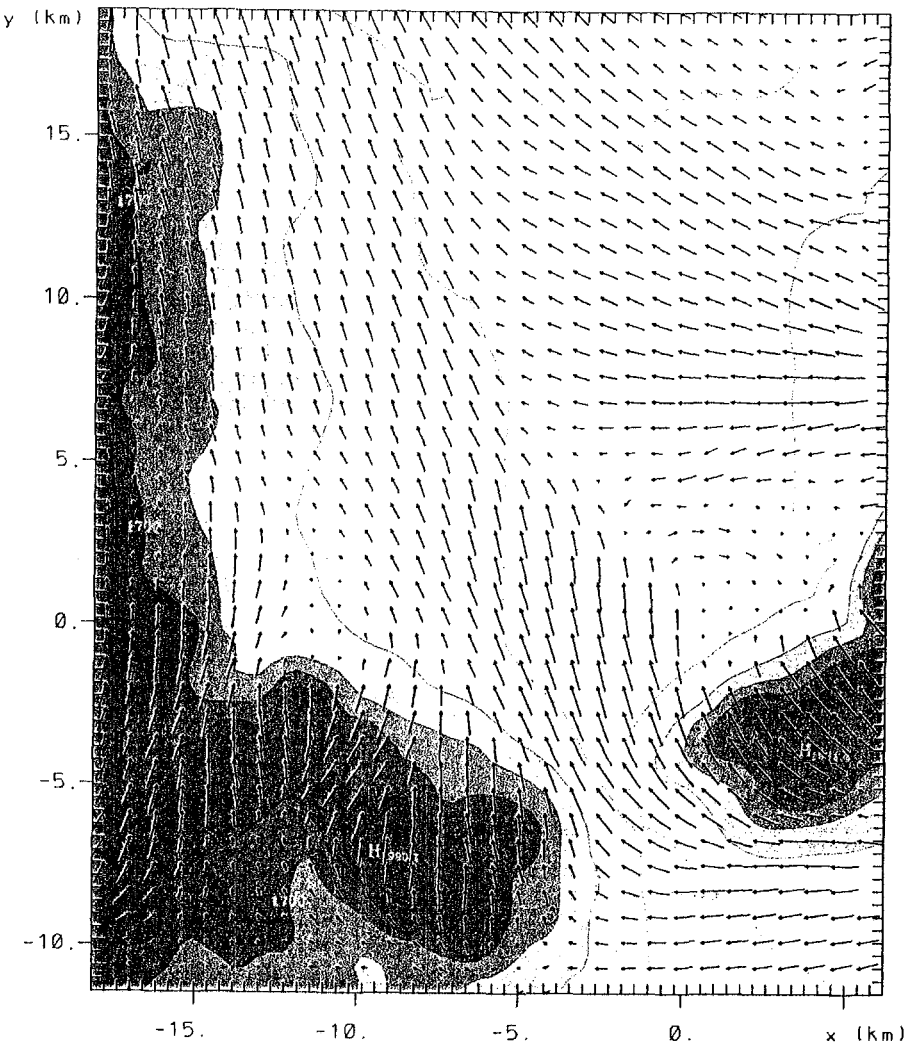


z= 50 m vertical velocity contour interval 0.1 m/s

0700 UTC 18 October



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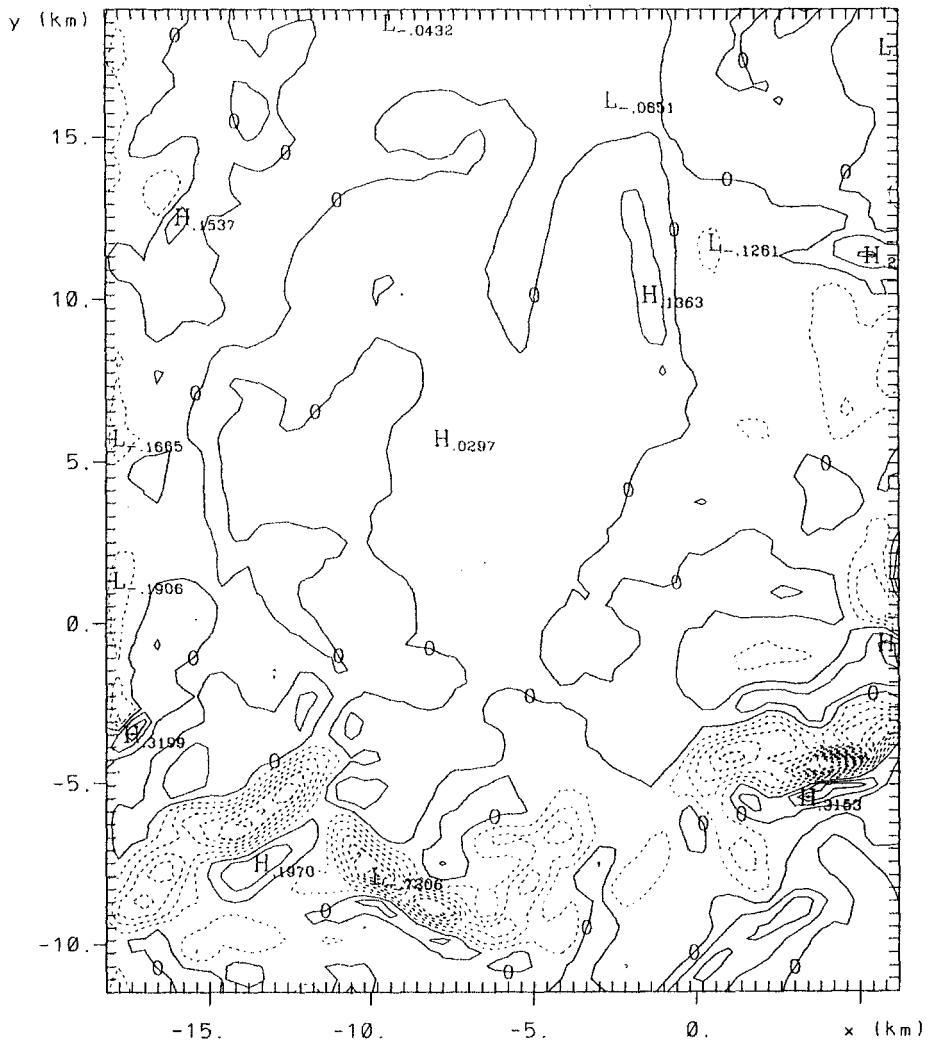

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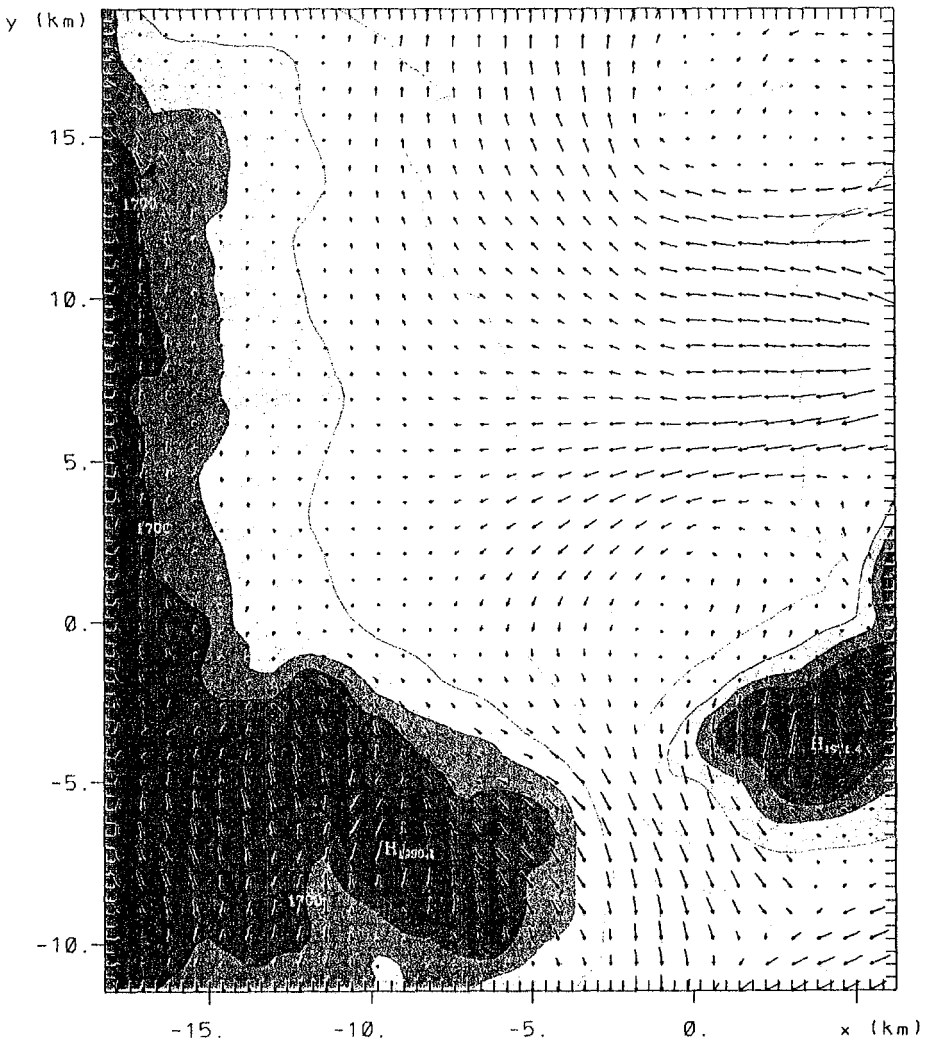

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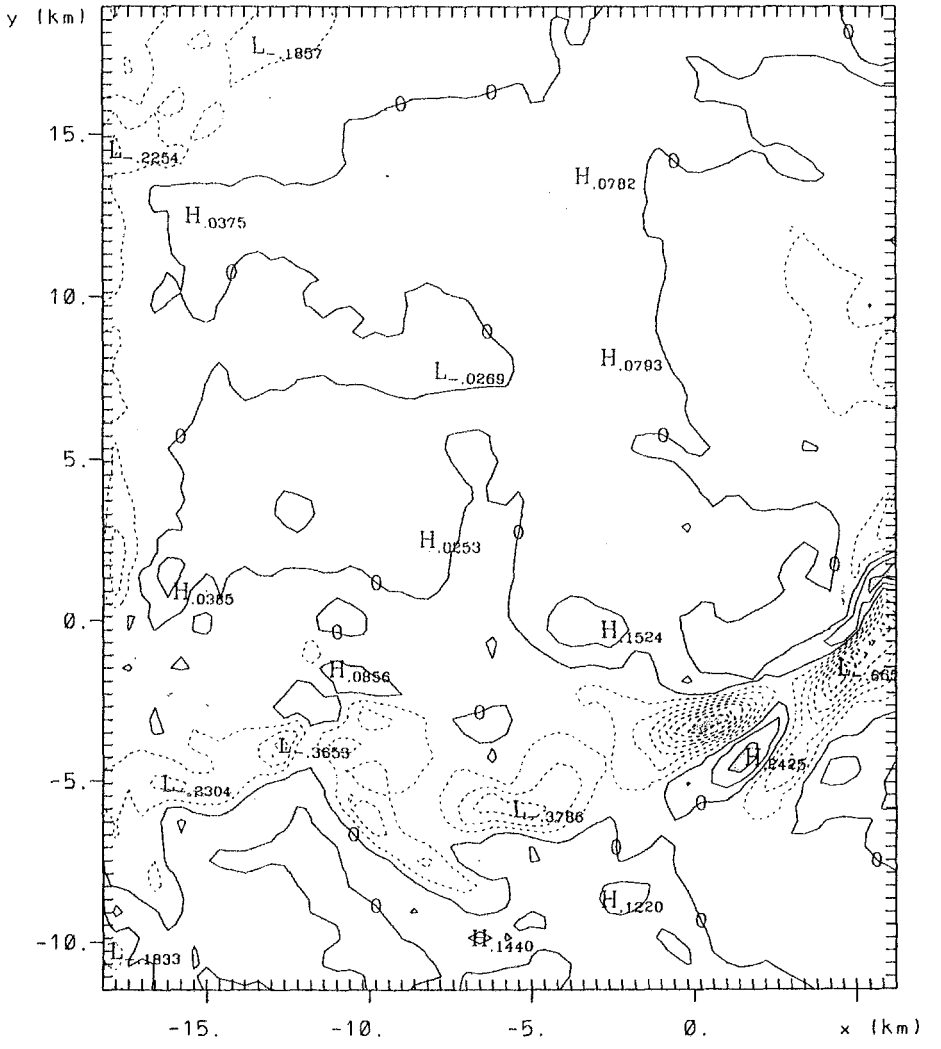

z= 50 m vertical velocity contour interval 0.1 m/s

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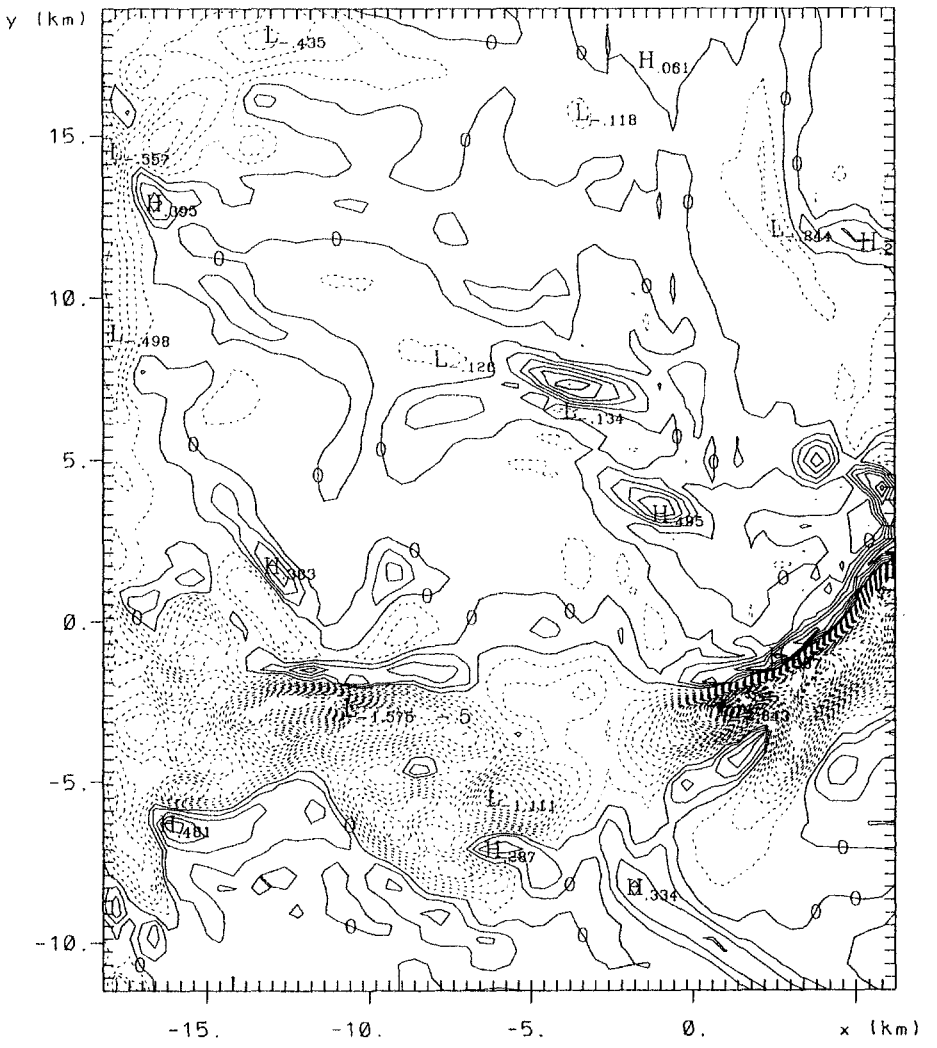

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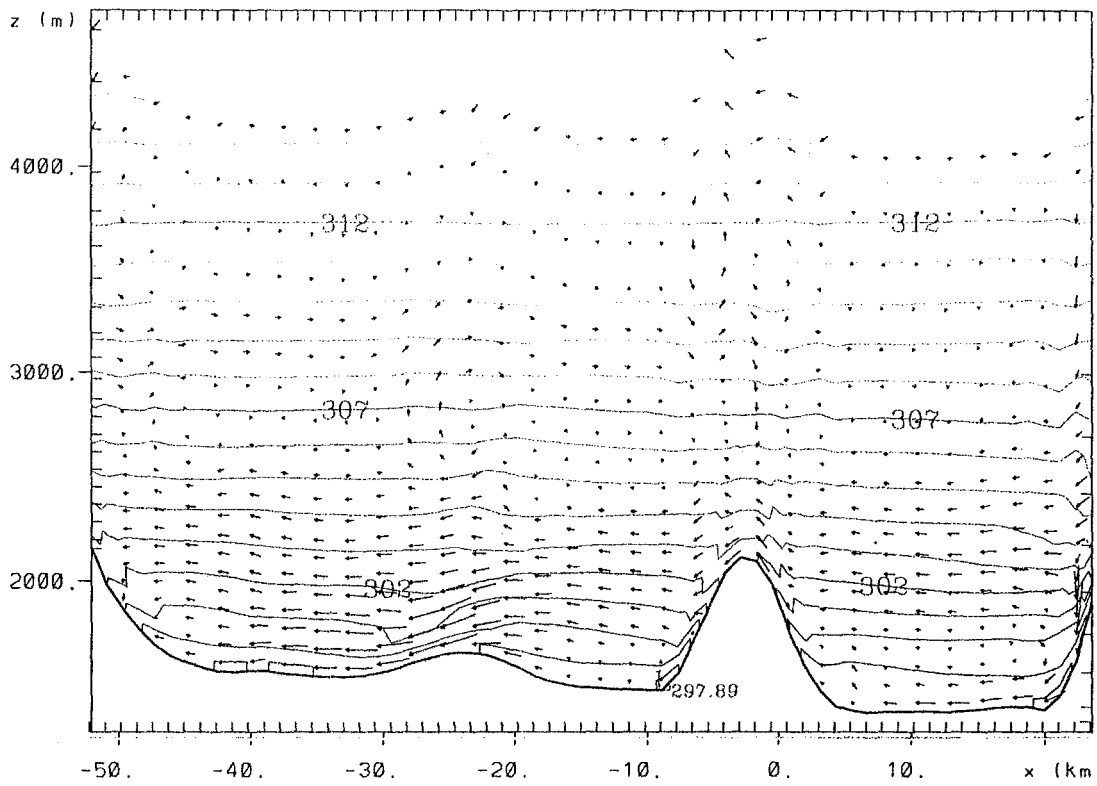
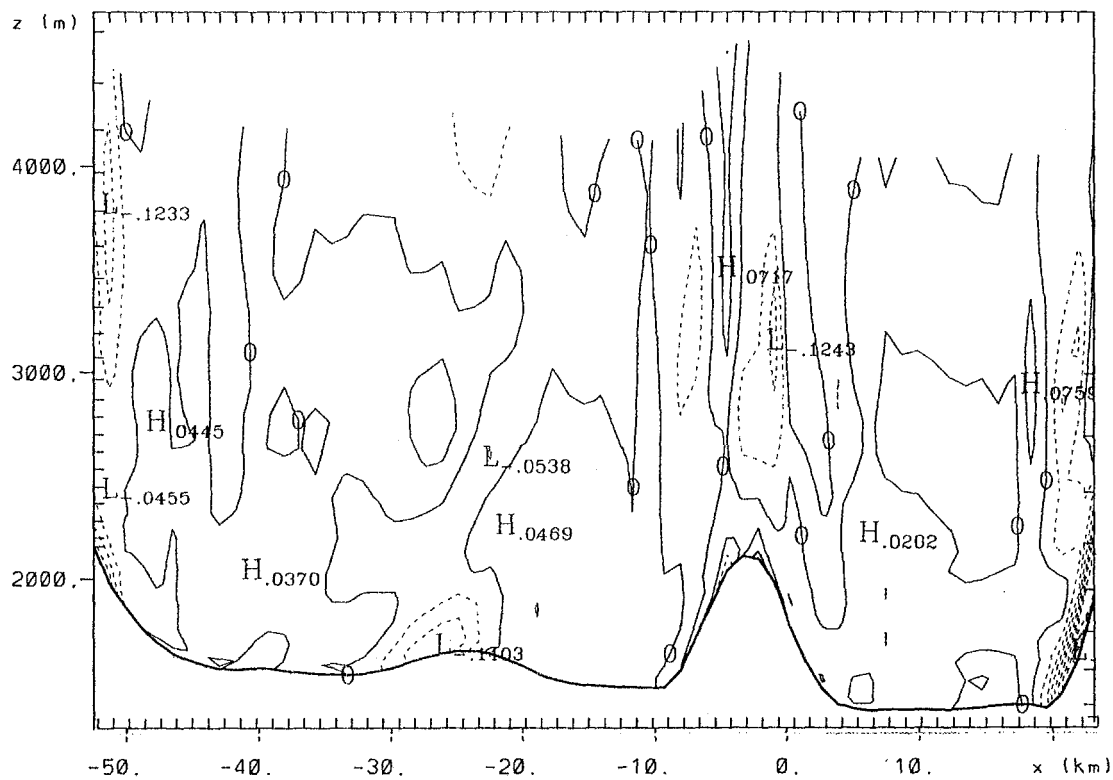


Potential temperature contour interval 1 K

reinforcing E winds aloft



Vertical velocity contour interval 0.05 m/s

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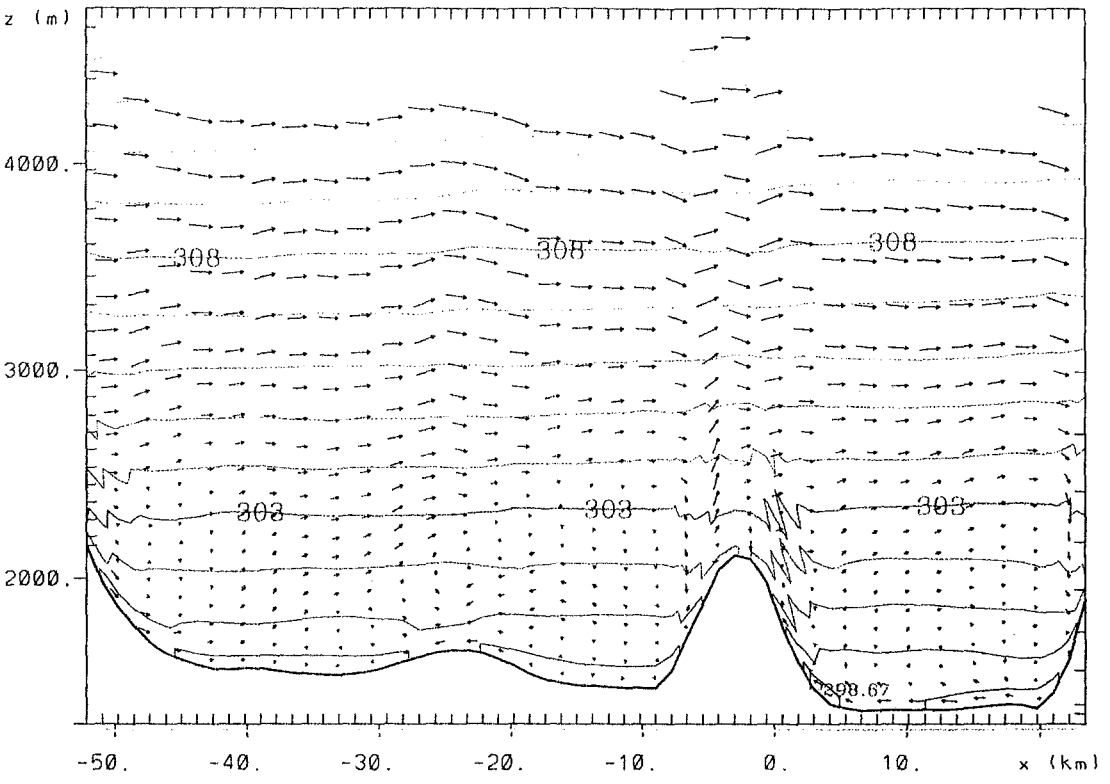
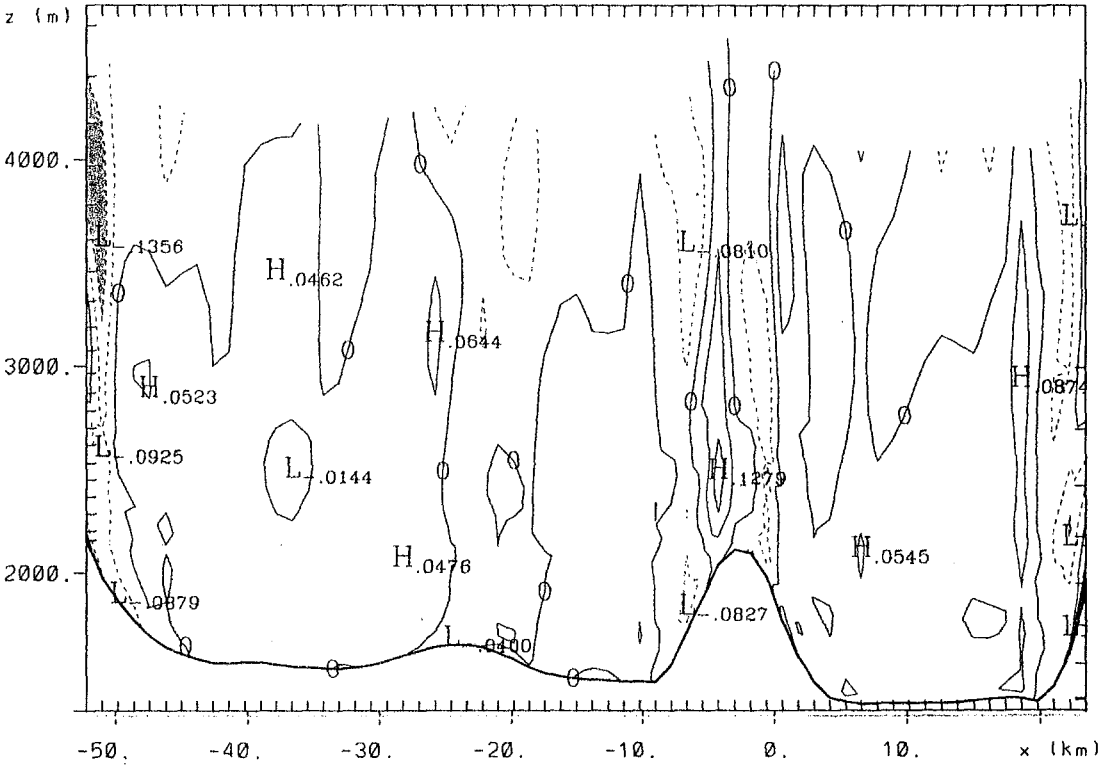


Potential temperature contour interval 1 K

West wind aloft + light east at sfc.



Vertical velocity contour interval 0.05 m/s

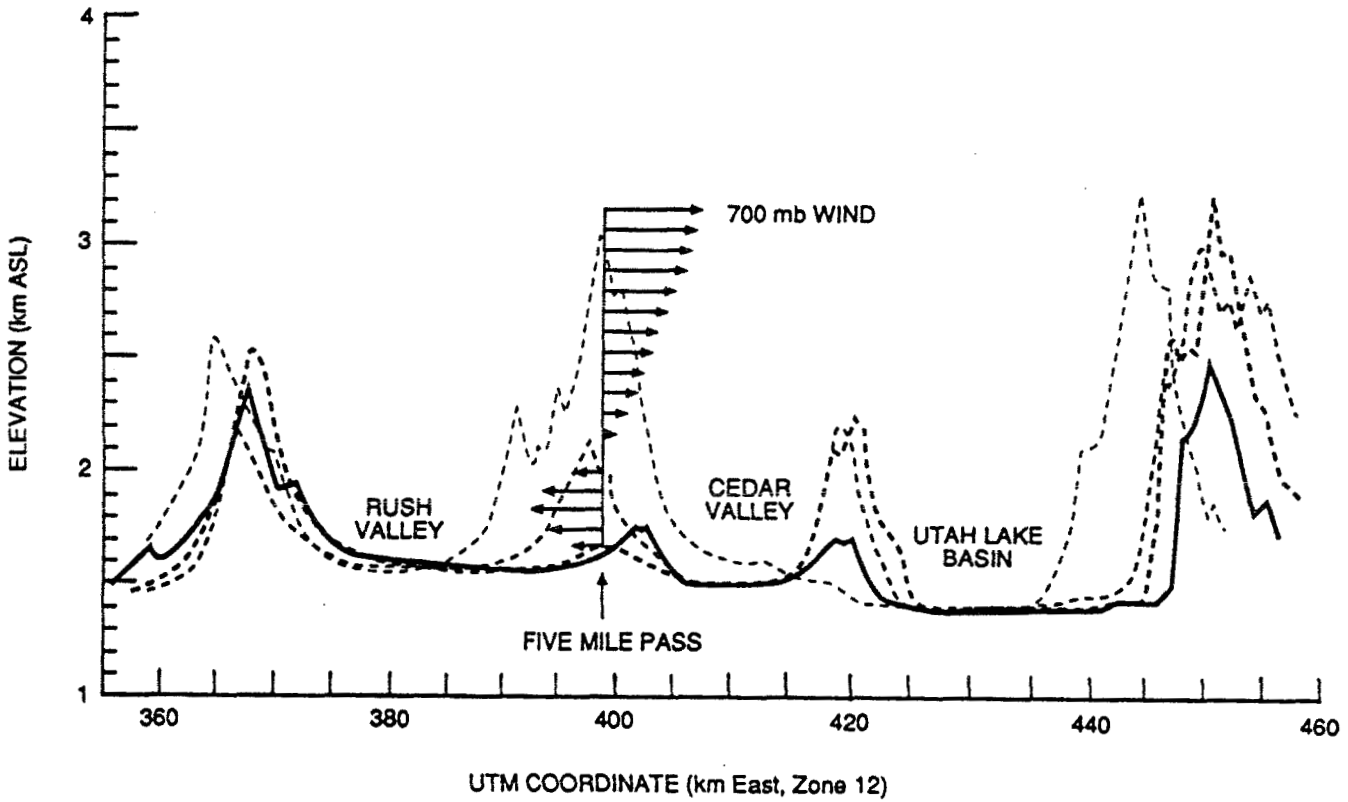


Fig. 5. Vertical profile of the E-W component of the wind above Fivemile Pass, 0500 MST, August 5. The dark heavy line is a west-to-east section of the terrain 5 km south of the pass. The heavy dashed line is a terrain section through the pass, and the lighter dashed lines are sections 5 and 15 km north of the pass. The vertical scale has been exaggerated 20 times.

Stone + Haard (1990)

Summary of Preliminary Findings

- The simulations indicate that synoptic conditions influence the strength and onset times of canyon outflows and valley flow in the Salt Lake City basin.
- The interaction of canyon outflows and valley flow determine the location and intensity of localized areas of vertical motion.
- Areas of vertical motion can change in their strength and their location under different synoptic conditions.
- East winds at Five Mile Pass appear to result from drainage off of the Wasatch and Lake Mountains and can be reinforced by easterly synoptic flow.

Future Plans

- Continue analysis of preliminary simulations with more comparisons to VTMX field observations.
- Explore improving RAMS simulations with modifications to the grid configurations and input data
- Explore using the Higrad model
- Simulate different synoptic conditions found during other IOPs