Western Region Technical Attachment
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THE BROOKINGS EFFECT

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Forecasting maximum temperatures at Brookings, Oregon has always been a challenge when the "Brookings Effect" becomes important. Temperature forecast errors of up to 30 degrees or more have occurred during these episodes. Several other studies (Capell, 1953; Mass, 1985; and Nishimoto, 1975) have looked at warming caused by this "Brookings Effect". This study goes one step further by helping the forecaster determine if and when the "Brookings Effect" may occur, which will ultimately help reduce temperature forecast errors.

What is the "Brookings Effect"?

The city of Brookings is located along the extreme southern Oregon coast and is situated at the mouth of the Chetco River, a northeast-to-southwest oriented river basin draining out of the Siskiyou Mountains (Figure 1). The "Brookings Effect" occurs when the air flow aloft parallels the river basin, resulting in adiabatic warming in the interior of the basin. If the downslope, low-level, offshore flow is strong enough, it erodes the low-level marine layer typically present in the town. During these episodes, temperatures in Brookings usually match or exceed those from the areas just inland.

Maximum temperatures often jump 20 to 30 degrees above previous daily highs and may be sharply warmer than the adjacent coastal communities of Gold Beach, Oregon and Crescent City, California. For example, there have been times in the summer and fall when Brookings has had highs in the 90s, while Crescent City, only 28 miles to the south, had highs in the 60s. The National Climatic Data Center has, at times, considered these extreme maximums at Brookings to be in error since they were so much higher than those from surrounding sites.

The "Brookings Effect" can occur any time of the year. Since records began at Brookings in 1913, the city has experienced Oregon's all-time warmest temperatures for each of the following months: November (88 degrees), December (79 degrees), January (78 degrees), February (83 degrees) and March (88 degrees). Though not state records, the remaining monthly record highs at Brookings have been in the 90s, with 103 degrees the all-time record high set in September.

Study

This particular study was conducted from 1987 through 1991. During this time, episodes of very warm temperatures at Brookings were archived to establish a composite model of the weather pattern favorable for the "Brookings Effect".

Figure 2 shows the composite surface pressure pattern (contoured for each mb) for the summer and winter seasons. The California surface thermal trough extends north just off the southern Oregon coast. Note the east-west orientation of the isobars along the southern Oregon coast, which is an important element in the offshore flow for the "Brookings Effect". Sea-level pressure at Medford was always higher than that at Brookings.

Figure 3 shows the composite 850 mb pattern. Note the northeast-to-southwest oriented contour lines, parallel to the Chetco River Basin. The 850 mb level is close to the top of the mountainous terrain of the river's headwaters. The 850 mb winds at Medford or surface winds at Sexton Summit from the northeast helped indicate the strength of the low-level flow. The pattern at higher levels was more varied (not shown), basically characterized by an upper-level ridge off the Pacific Northwest coast and anti-cyclonic flow over Oregon and Washington.

When the synoptic setting necessary for the "Brookings Effect" is in place, a close estimate of the Brookings maximum temperature can be made from numerical model output. First, 00Z 850 mb temperature forecast for the point near the Chetco River headwaters must be determined. Then, on a thermodynamic diagram, warm that temperature dry adiabatically to sea level to determine a good estimate of the surface maximum.

Any forecast surface or low-level pattern that fails to closely match these composites, <u>will not</u> result in the "Brookings Effect". For instance, if the surface thermal trough moves onto the coast or a little onshore, the warm downslope flow will not erode the marine layer. If the 850 mb air flow becomes either more northerly or more easterly, the downslope flow down the river basin becomes sharply reduced or eliminated.

Historically, forecasters should be aware that extreme temperature episodes at Brookings have rarely extended more than two days in a row. The thermal surface trough usually extends north along the Oregon coast or shifts inland as the overall weather pattern changes.
Figures 4, 5, 6 and 7 show a good example of the "Brookings Effect" during a typical event. Figures 4 and 5 show the surface sea-level pressure field and 850 mb analysis for 00Z October 20, 21, and 22, 1991. Note the sea-level pressure gradient between Brookings and Medford on the surface maps. Figure 6 shows the 00Z Medford 850 mb temperatures each day, traced dry adiabatically to sea level at Brookings on a Pseudo-Adiabatic Chart. Note how the sea-level temperatures closely match the maximums for Brookings on the 19th and 20th of October given in Table 1. Table 1 also compares the extreme temperatures at Brookings on October 19 and 20 to surrounding coastal and inland sites. [Figure 7 is a sequence of the observations from Brookings on the 19th and 20th. Note how the winds held the minimum temperature up on the morning of the 20th, offering another challenge to the forecaster.]

In summary, the "Brookings Effect" is the result of downslope, low-level, offshore air flow through the Chetco River Basin into Brookings. This "Brookings Effect" may occur any time of the year and results in dramatically warmer maximum temperatures in Brookings compared to the previous or following days, and compared to nearby coastal communities. The results of this study take time to thoroughly verify, but may produce more accurate temperature forecasts at Brookings if the "Brookings Effect" can be identified in advance.

References

Capell, John C., 1953: Mechanics of the California-Oregon Heat Low. U.S. Weather Bureau Fire Weather Conference, March 4, 1953, Portland, Oregon, 9p.

Mass, Clifford F., November 1985: The "Banana Belt" of Oregon's South Coast. Dept of Atmospheric Sciences, University of Washington, 14p.

Nishimoto, Frank S., June 1975: Maximum Temperature Aid for Brookings, Oregon, Local Study, National Weather Service, Portland, Oregon, 1p.

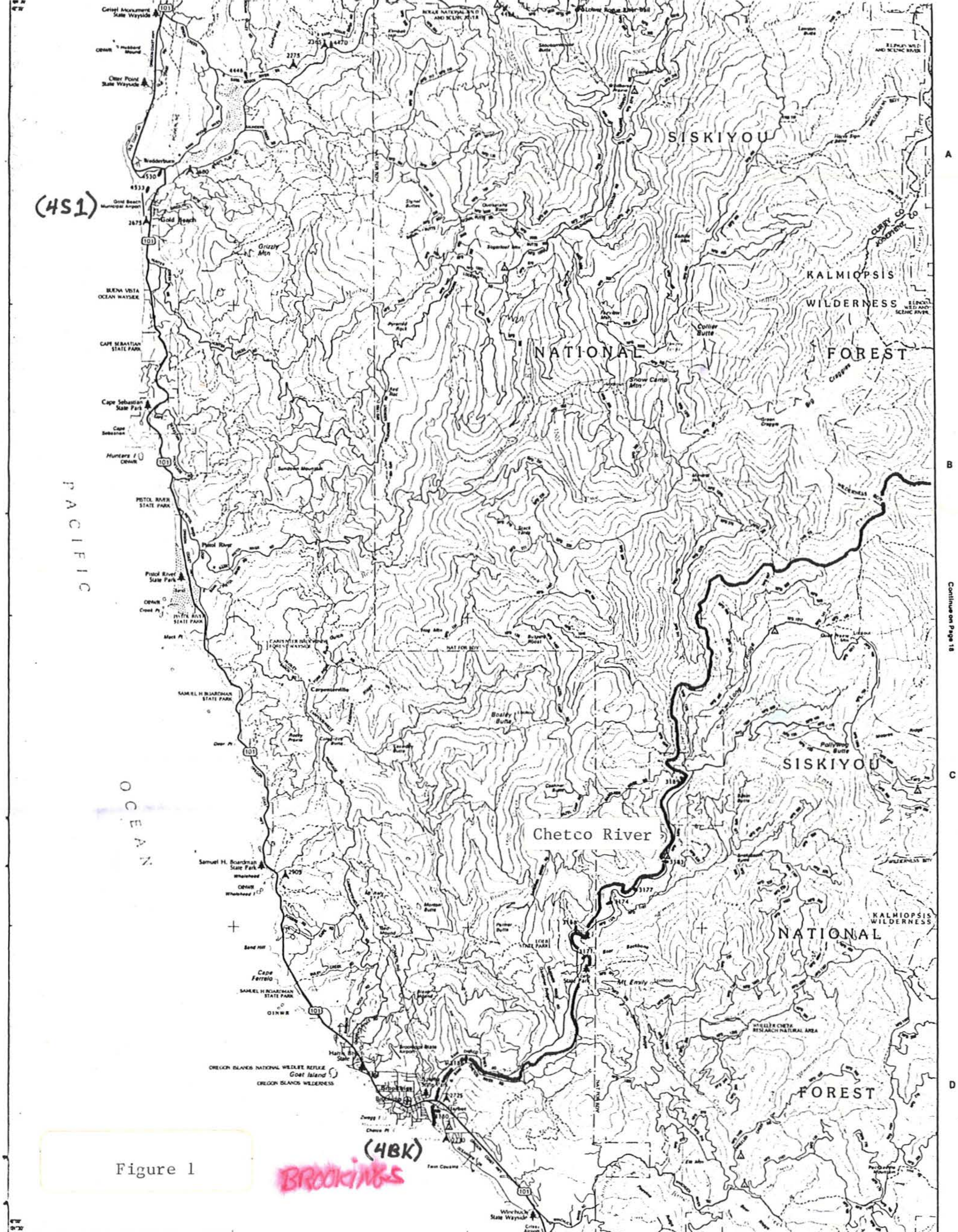


Figure 1

KILOMETERS 1 0 1 2 3 4 5 6 7 8 9 10

MILES 1 0 1 2 3 4 5 6

Scale 1:150,000
1 inch represents 2.4 miles

Contour interval
300 feet (91.4 meters)

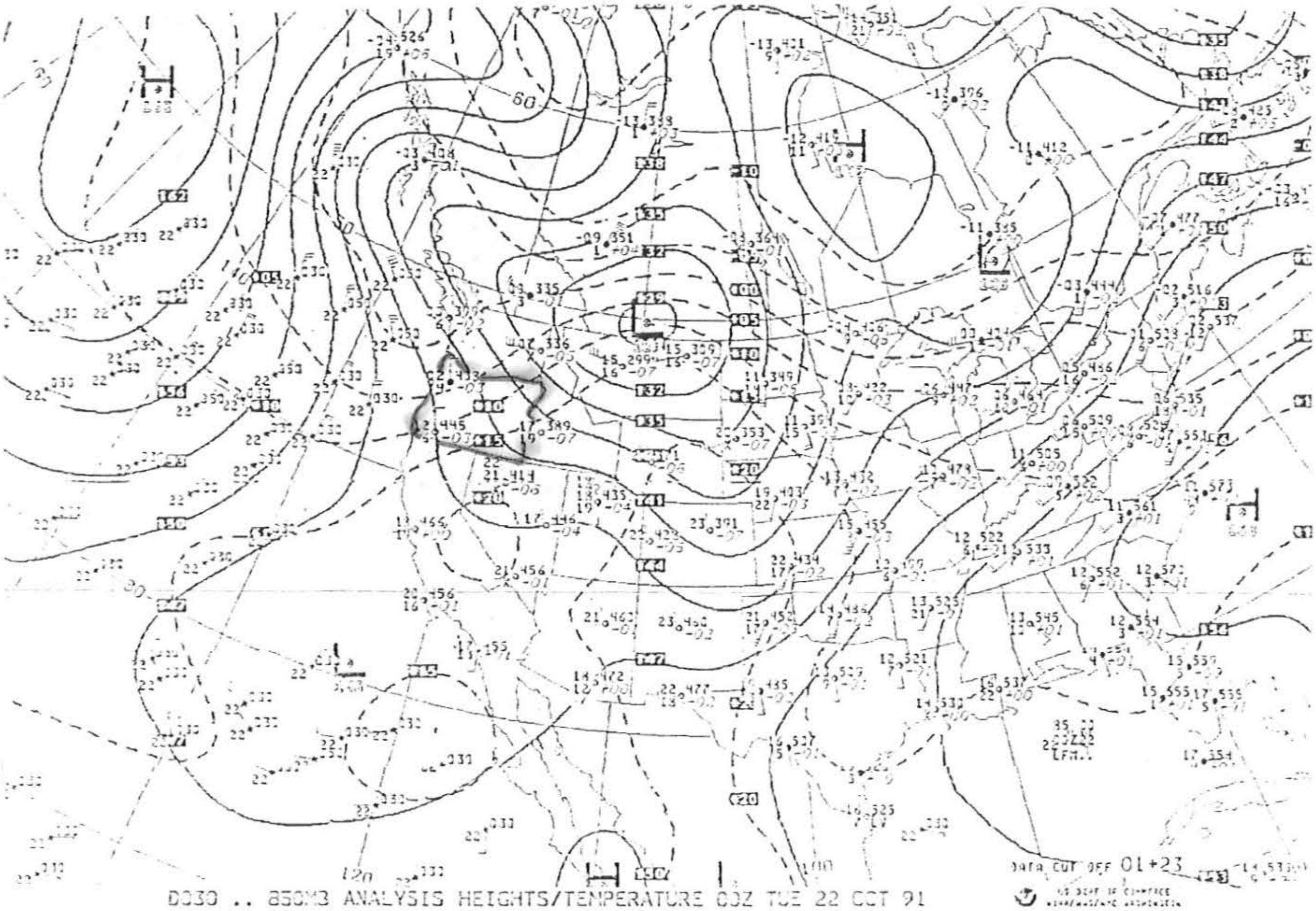
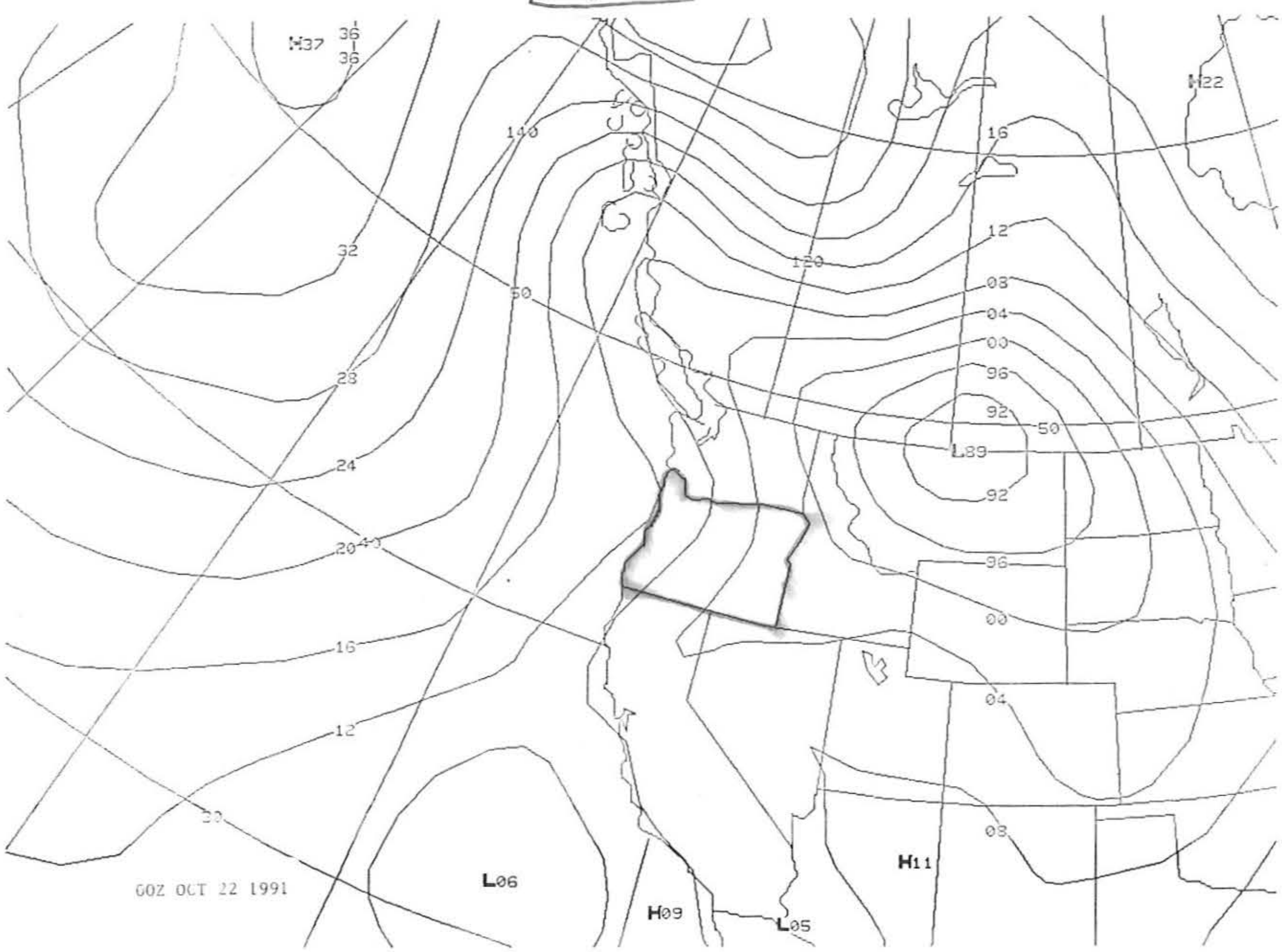

D030 .. 850MB ANALYSIS HEIGHTS/TEMPERATURE 00Z TUE 22 OCT 91
DATA CUT OFF 01+23

Figure 5


00Z OCT 22 1991

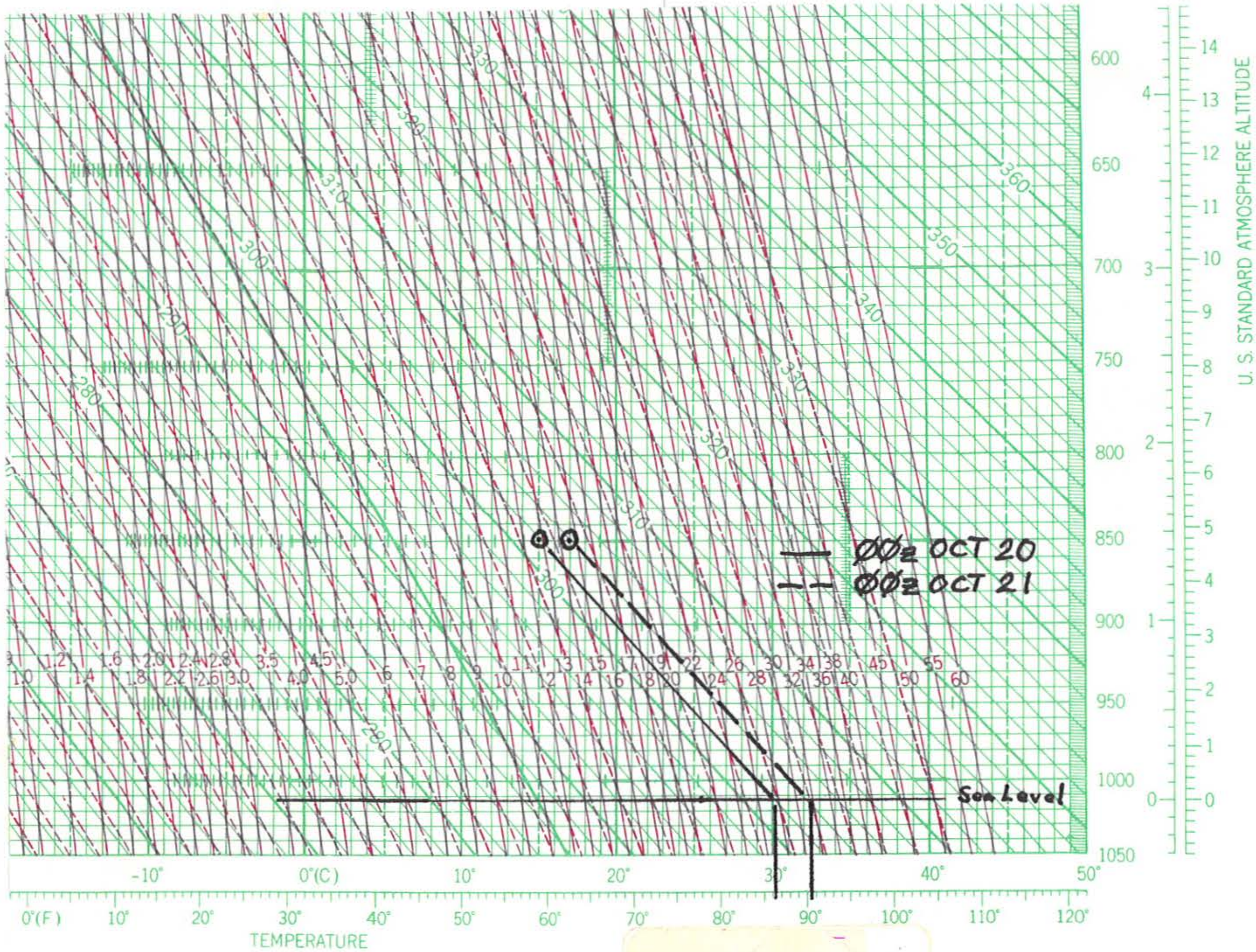


Figure 6

Table 1

1991	October	17	18	19	20	21	22
				Maximum / Minimum			
Gold Beach		66/53	67/43	69/49	70/48	73/44	55/44
Brookings		72/48	69/44	**88**/47	**92**/63	73/51	57/42
Crescent City		64/55	62/55	62/57	65/56	65/57	61/56
Sexton Summit		60/40	62/50	61/54	69/50	73/40	41/34
Grants Pass		73/52	73/33	81/33	81/38	73/40	56/32
Medford		74/45	72/36	77/35	79/35	76/40	58/37

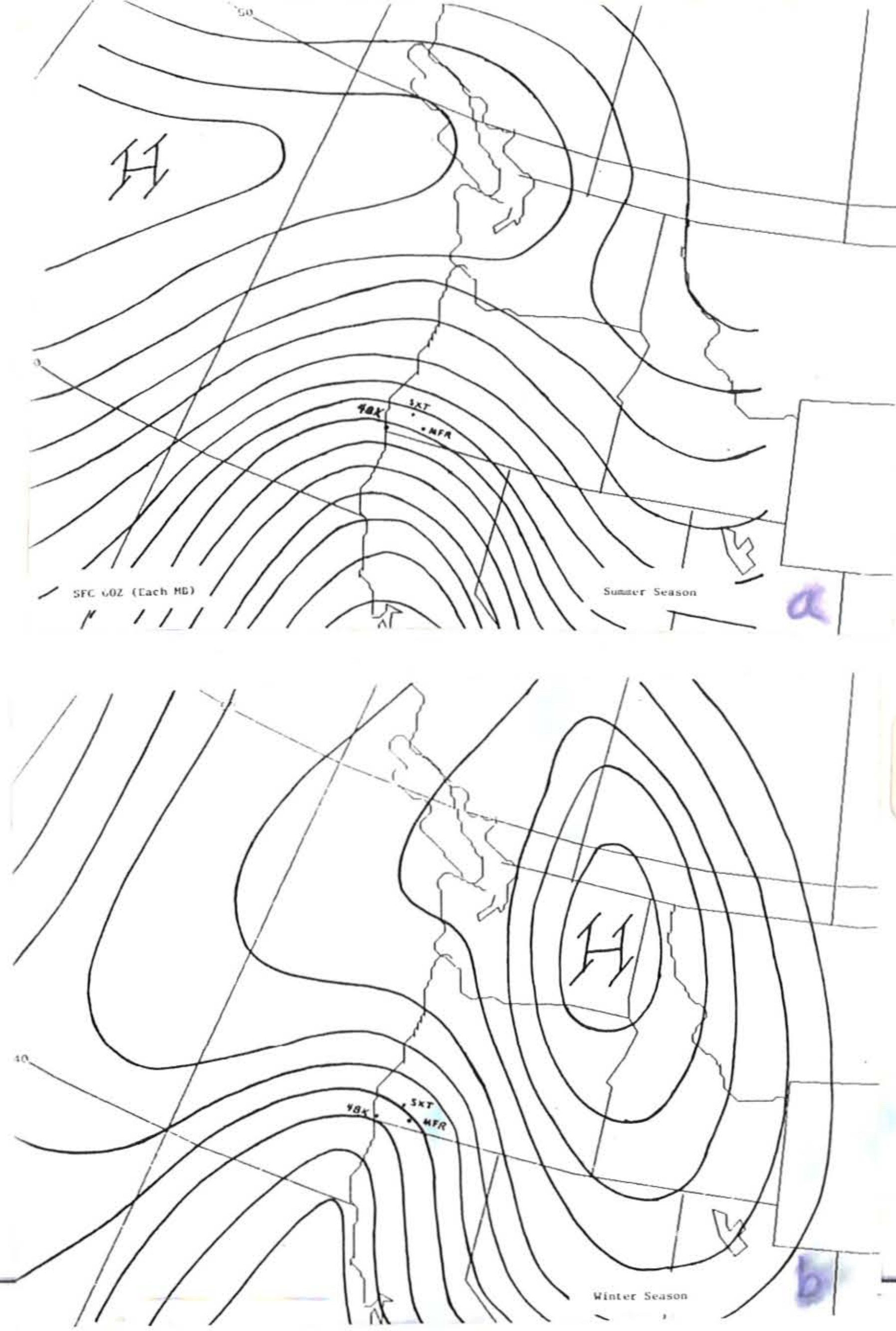


Figure 2

a) SFC 00Z Summer

b) SFC 00Z Winter

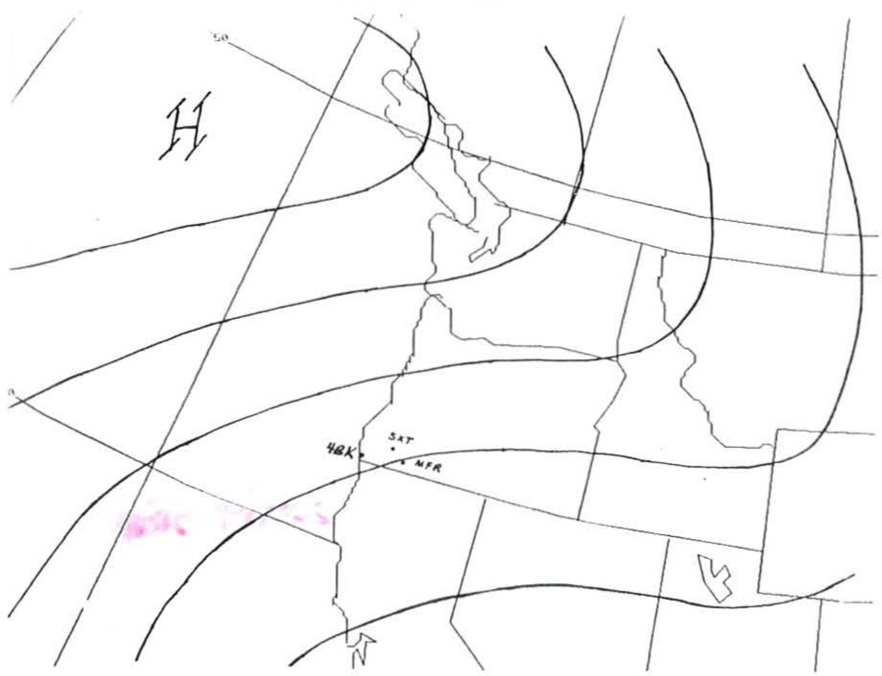


Figure 3
850 mb 00Z

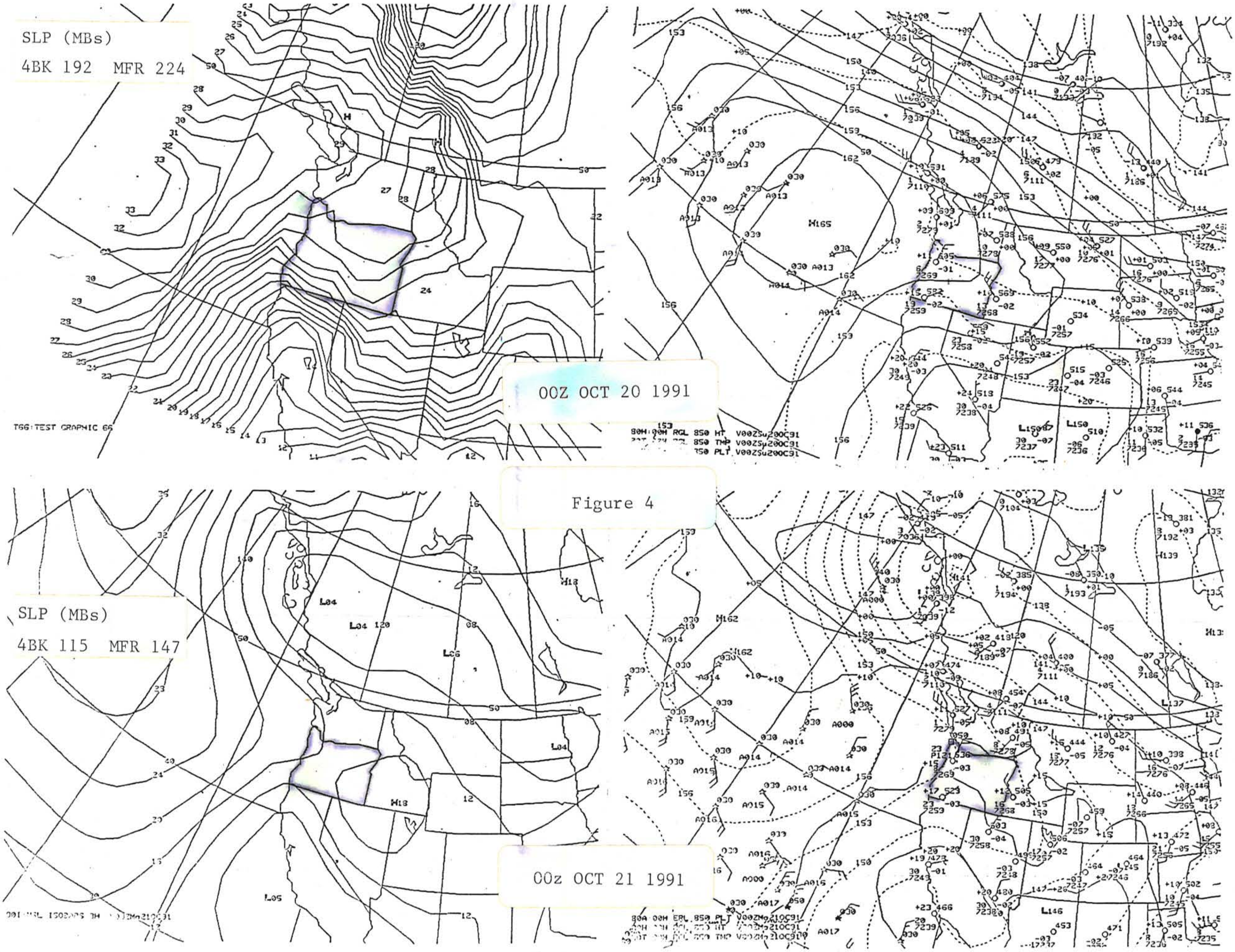

SLP (MBs)
4BK 192 MFR 224
00Z OCT 20 1991
SLP (MBs)
4BK 115 MFR 147
00z OCT 21 1991

Figure 4