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OREGON COAST STORM OF JULY 4, 1986

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[Editor's Note: Although the following storm occurred in mid-summer, it was unusual for that time of year. Such rapidly deepening ocean storms are more common during the cool half of the season. As was the case here, numerical models often fail to catch the strong low level deepening of such storms. Forecasters should closely monitor those clues mentioned in the summary for unpredicted development, especially during the upcoming cool season.]

Early in the morning Pacific Daylight Time, on July 4, 1986, a small intensifying low pressure system moved onto the central Oregon coast (Figure 1). Winds from unofficial locations of up to 100 m.p.h. were received. Lesser intensities were recorded at official locations. The storm did a moderate amount of damage in the way of blown-down trees and power lines. Some moored fishing boats were also sunk. Damage was confined to a narrow area along the coast from Heceta Head to Reedsport.

The storm was anomalous in that it disrupted the normal summer pressure pattern along the coast. That pattern consists of a high pressure offshore with prevailing northwesterly winds. It was also unusual in that the damage occurred not with strong southerly winds ahead of the storm but with northerly winds as it moved onshore and inland.

UPPER AIR CHARTS

The 500-mb chart for 5 a.m. PDT, July 3, 1986 (Figure 2a), showed a broad trough along the west coast of the United States and Canada. The air in this trough was unseasonably cold with the temperature at Port Hardy, British Columbia, Canada, reported as -29°C. By 5 p.m., PDT, July 3 (Figure 2b), the trough began to sharpen as a strong short wave rotated south. At 5 a.m. PDT, July 4 (Figure 2c), a 12-hour height fall of 200 meters had occurred at Salem, Oregon, and the trough was just off the west coast. Strong cold air advection was occurring. The trough began to weaken and moved east by 5 p.m. PDT, July 4 (Figure 2d).

The 250-mb analysis for 5 a.m. PDT, July 3 (Figure 3a), has a 150-knot jet maximum analyzed at 48°N/140°W. The 250-mb charts for 5 p.m. PDT, July 3, and 5 a.m. PDT, July 4 (Figure 3b and 3c), continue a strong cyclonically curved jet in excess of 110 knots entering and transiting Oregon.

SURFACE CHARTS

A series of small scale surface charts were drawn at three-hourly intervals from 5 p.m. PDT, July 3, to 5 a.m. PDT, July 4. At 5 p.m. PDT, pressure falls of 1.5 to 3.0 millibars can be seen over much of the Pacific Northwest (Figure 4a). Most of the fall in pressure can be attributed to the normal diurnal cycle. This same chart also shows pressure falls of 2.8 and 3.4 millibars at two buoy locations offshore. These falls are considerably larger than normal diurnal falls. At 8 p.m. PDT, July 3 (Figure 4b), a surface low with a central pressure of 1009 millibars can be drawn offshore near 45°N/128°W. Large dynamically induced pressure falls continue along and off the coast.

At 11 p.m. PDT, July 3 (Figure 4c), diurnal falls of pressure had ceased, but unusual falls of over two millibars were occurring along the Oregon coast. These falls increased and expanded inland by 2 a.m. PDT (Figure 4d). By 5 a.m. PDT, July 4, the low had moved inland, and rapid rises had begun along the coast (Figure 4e).

SATELLITE PICTURES

The 9 a.m. PDT, satellite picture for July 3 (Figure 5a), showed a baroclinic zone between 45°N and 50°N westward off the Washington coast. By 8:30 p.m. PDT, July 3, this zone had moved southward and eastward to between 125°W and 130°W (Figure 5b). At 11:30 p.m. PDT, July 3, the low was showing characteristics of deepening low centers. It had assumed a "comma" configuration and had two parallel areas of high cloud separated by a narrow band of lower cloud. These characteristics have been observed in other intensifying eastern Pacific storms, most notable being the November 13, 1981 storm. The two areas of high cloud are marked in Figure 5c as the two letters "A" and the separation as the Letter "B". By 2 a.m. PDT, July 4, the storm had a "dry slot" at 45°N/125W working its way northeastward into the center (Figure 5d).

PRESSURE FALLS

Figure 6 is a plot of the surface pressure at the Newport Coastal-Marine Automated Network (C-MAN) site on the south jetty. A steady fall is noted from 5 p.m. PDT, July 3, to around 4 a.m. PDT, July 4. During this eleven-hour period, a fall of 14 millibars was observed. Indeed, from 11 p.m. PDT, July 3, to 3 a.m. PDT, July 4, the pressure fell 8.2 millibars, or about two millibars per hour.

Surface low centers, central pressure, and frontal positions of the storm are shown in Figure 7. In nine hours from 5 p.m. PDT, July 3, to 2 a.m. PDT, July 4, the central pressure of the storm fell nine millibars. The lowest central pressure was estimated at 1000 millibars just as the low moved onshore around 4 a.m. PDT, July 4, 1986.

NUMERICAL GUIDANCE

With such a deep low and cold temperatures analyzed at 500 mbs and such a strong jet analyzed at 250 mbs as early as 12Z on July 3, one would expect numerical models to have a pretty good handle on the mid and upper level development associated with this storm. Comparison of the LFM and NGM 24-hour 500-mb prognoses valid July 4, at 12Z (Figure 8), with the 500-mb analysis in Figure 2c verifies this assessment. Both models predicted a strong short wave along the central Oregon coast.

In retrospect, the development predicted aloft probably should have been a clue that something might develop at low levels. However, neither model predicted any surface development near the Oregon coast at all (Figure 9).

WIND REPORTS AND DAMAGE

There were many reports of wind and some reports of wind damage. Unofficial reports of 60 to 70 m.p.h. and stronger were received from a utility company and 100 m.p.h. from a business just north of Florence. Officially, the C-MAN site at Cape Arago recorded a peak gust of 22.2 meters per second (50 m.p.h.) from the south at 2 a.m. PDT, July 4. Cape Blanco to the south recorded a peak gust of 53 knots (61 m.p.h.) between 2 a.m. PDT, and 5 a.m. PDT, July 4, with the direction also from the south. A Bonneville Power administration anemometer recorded 66 m.p.h. at the same Cape Blanco location but is 20 feet higher.

The storm moved onshore somewhere between Heceta Head and Yachats. It was at the Sea Lion Caves just south of Heceta Head that the 100 m.p.h. report was recorded. A National Weather Service anemometer located on the U. S. Coast Guard watch tower at the Siuslaw River north jetty had 68 m.p.h. At the C-MAN site near Newport a gust of 40 m.p.h. was recorded out of the north at 5 a.m. PDT, July 4, as the pressure was rising rapidly.

Damage was limited to a narrow strip from Florence south to Tahkenitch Lake. Numerous trees were blown down in campgrounds with some automobiles and recreational vehicles receiving damage. At Siltcoos Lake, twelve boats were torn from their moorings, at the southeast corner of the lake and were sunk. The Central Lincoln Public Utilities District reported very little damage in the town of Florence, but many power lines were down south of that location. Conversation with the Florence City manager confirmed the minimal damage in the town.

In a telephone interview with a representative of the Central Lincoln Public Utilities District, the spokesperson remarked that the winds "blew very strong from the south to southwest and then shifted abruptly to the north-northwest and blew even harder". Most of the trees that were blown down were oriented north-northwest (roots) to south-southeast (tops). The Central Lincoln PUD representative indicated most of their damage was in a small area from Honeyman State Park south to Tahkenitch Lake.

The 100 m.p.h. winds were reported at the Sea Lion Caves business north of Florence. It sits on a point of land about 250' above the ocean. Here shingles were torn from the roof on the north side of the building. The proprietor said that the strongest winds had come from a northerly direction. A 10-foot by 35-foot platform or observation deck was lifted up and moved about 50 feet directly south. The anemometer at the Sea Lion Caves is about 30 feet off the ground, but the cups are only about 18 inches to two feet above the roof that is sloped on all four sides. This undoubtedly caused some acceleration of the wind, as it came up the bluff and then up and over the building.

The entire area was inspected by an employee of the Eugene Weather Service Office on Saturday July 5. He confirmed the reports of damage from the narrow path from ~~just north of Florence south to just north of Reedsport.~~

CONCLUSION

Pacific storms that hit the Oregon and Washington coasts usually have the strongest winds ahead of them, that is, from a southerly direction. Once the associated surface front moves onshore, the winds shift to a westerly direction and decrease. This is what occurred from Reedsport, Oregon south. However, this time the strongest winds were post-frontal along a section of the coast, and this may have been one reason for the damage. Trees along the coast become acclimated to very strong southerly winds. Most have little defense when exposed to strong northerly winds in the categories reported.

There was some speculation among campers and residents that the winds were tornadic. Comments such as "It sounded like a freight train", were made. It seems unlikely that the damage was caused by a tornado or a "cold air funnel" because of two factors. First, the orientation of downed trees and damaged structures was mostly in one direction - toward the south. Second, the automatic lightning detection system (ALDS) used throughout the western United States to detect lightning recorded no strikes anywhere in western Oregon, July 3 and 4, 1986. This greatly reduces the possibility that a thunderstorm occurred.

Figure 10 is the upper air sounding from Salem, Oregon, for 5 a.m., PDT, July 4, 1986. Stability indices, although low, are not in the "zero" or "minus" categories. For the most part, the sounding is conditionally unstable.

SUMMARY

Between 10 p.m., PDT, July 3, and 8 a.m., PDT, July 4, 1986, an unseasonably intense but small storm hit the central Oregon coast. It caused some damage. However, the damage resulted not from southerly winds preceding the storm but strong northerly winds in the western quadrant of the low as it moved inland (Figure 11). Weather charts gave a few clues to its development.

(1) A jet maximum in excess of 130 knots approaching the coast.

(2) Anomalous surface pressure falls along the coast and inland after the normal diurnal pressure-fall cycle had ceased.

(3) Continuous surface pressure falls and then rises at offshore buoy locations.

(4) Cloud formations in satellite pictures that are generally indicative of storm intensification.

(5) Strong cold air advection at mid-levels in the atmosphere.

Numerical forecast models adequately predicted the upper tropospheric disturbance associated with this intense storm. However, they failed to predict the surface development and associated strong low-level winds.

Coastal residents and visitors were extremely fortunate that the storm hit in the early morning hours. Had the storm hit four hours later, numerous fishing vessels would have been on the ocean off Florence and on the inland lakes close by. One can only speculate about the results.

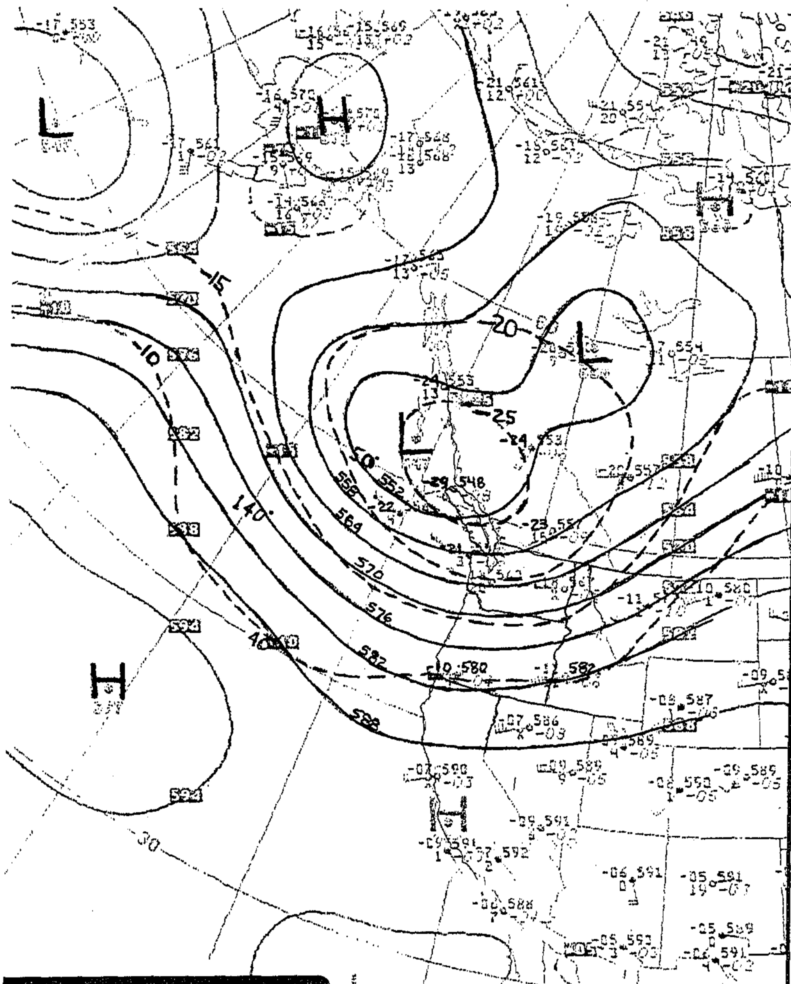

Fig. 2a. 500 mb, 5 AM PDT, July 3, 1986

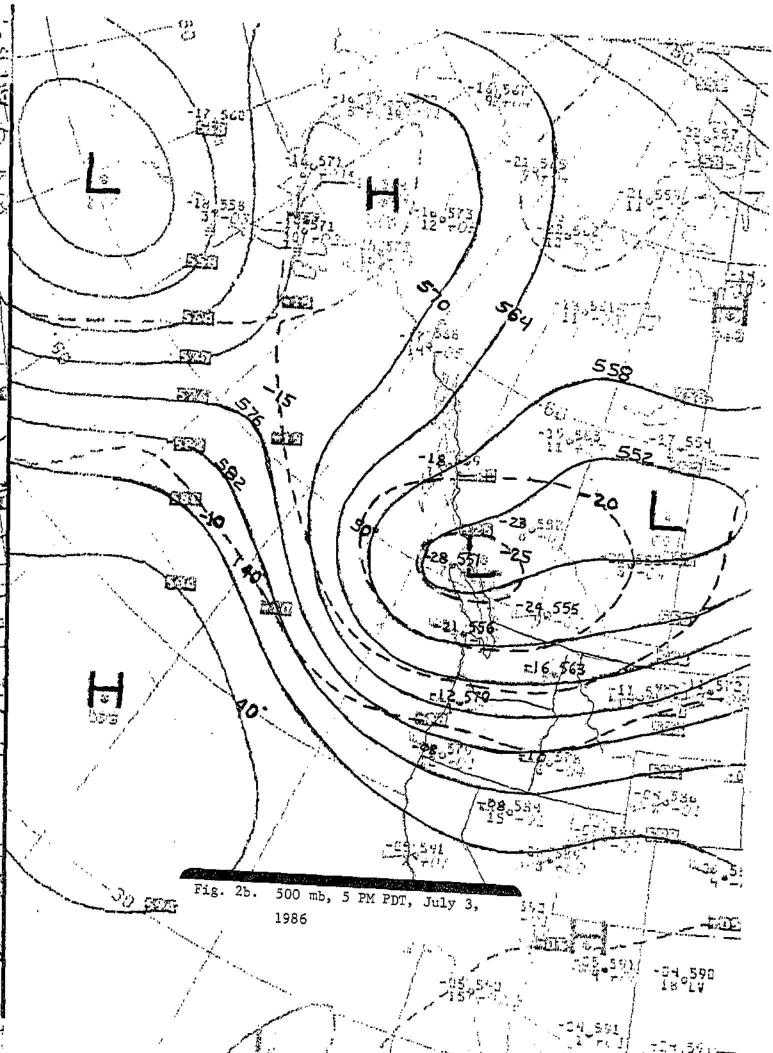

Fig. 2b. 500 mb, 5 PM PDT, July 3, 1986

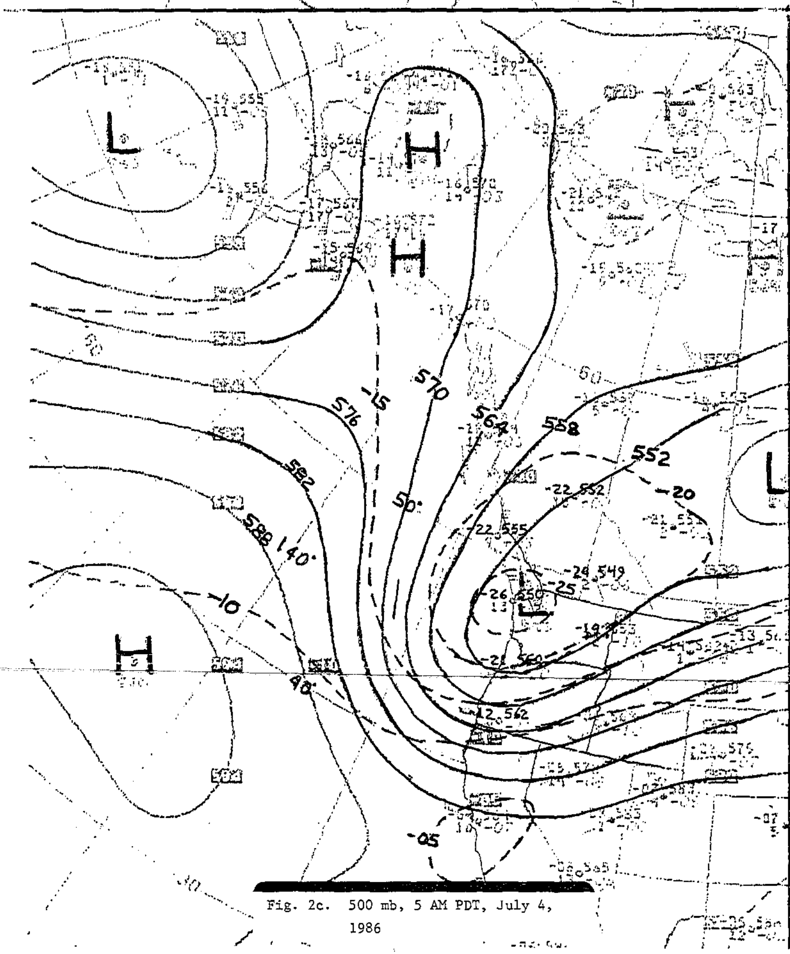

Fig. 2c. 500 mb, 5 AM PDT, July 4, 1986

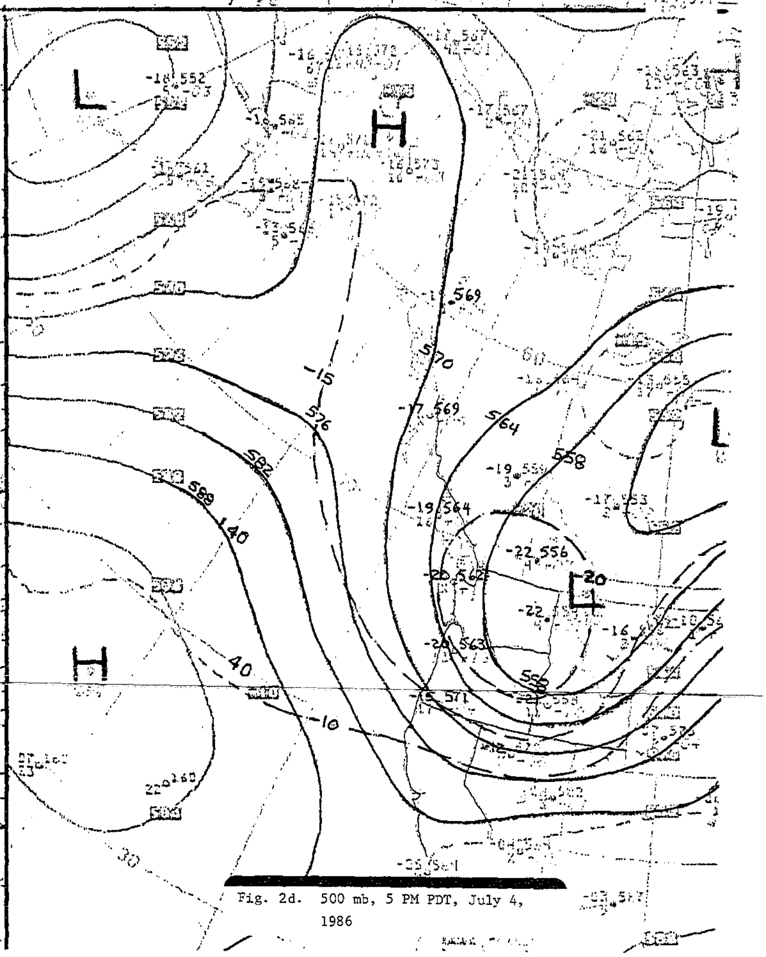

Fig. 2d. 500 mb, 5 PM PDT, July 4, 1986

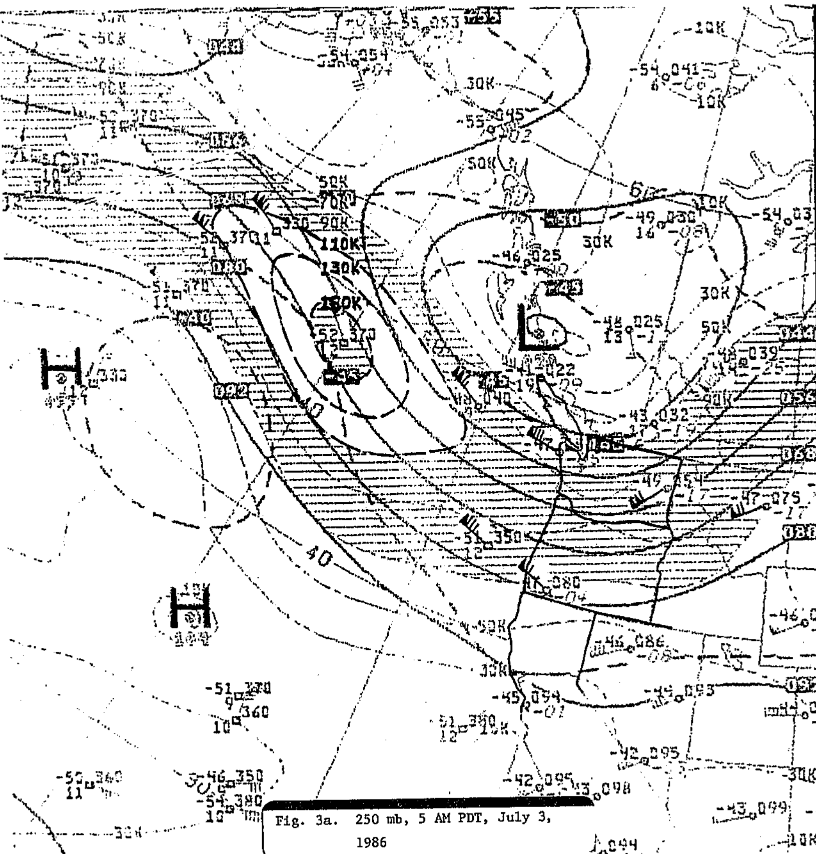

Fig. 3a. 250 mb, 5 AM PDT, July 3, 1986

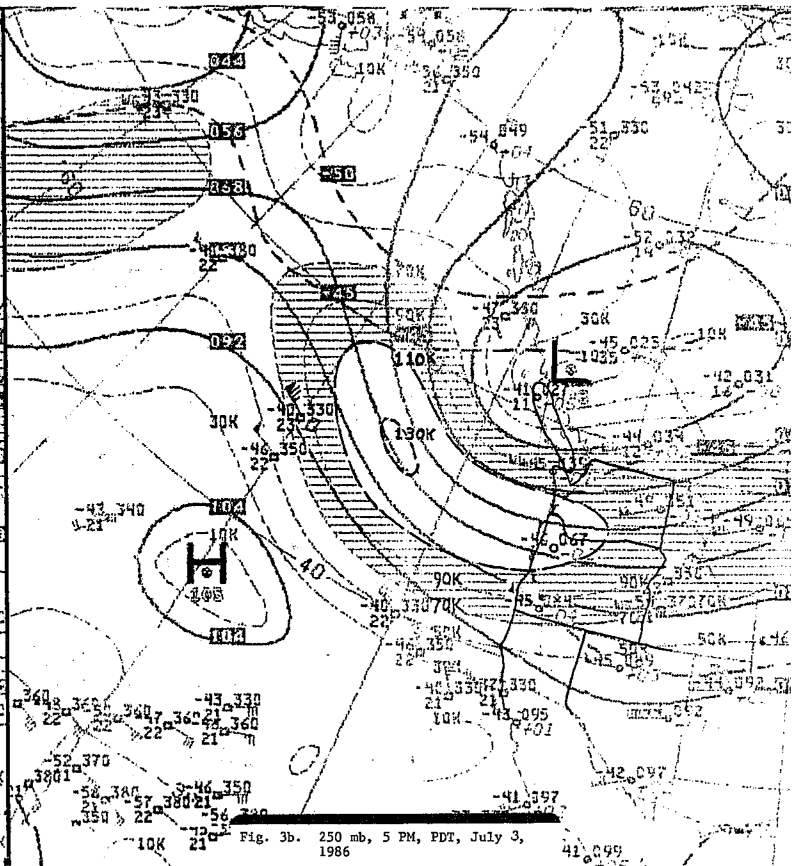

Fig. 3b. 250 mb, 5 PM, PDT, July 3, 1986

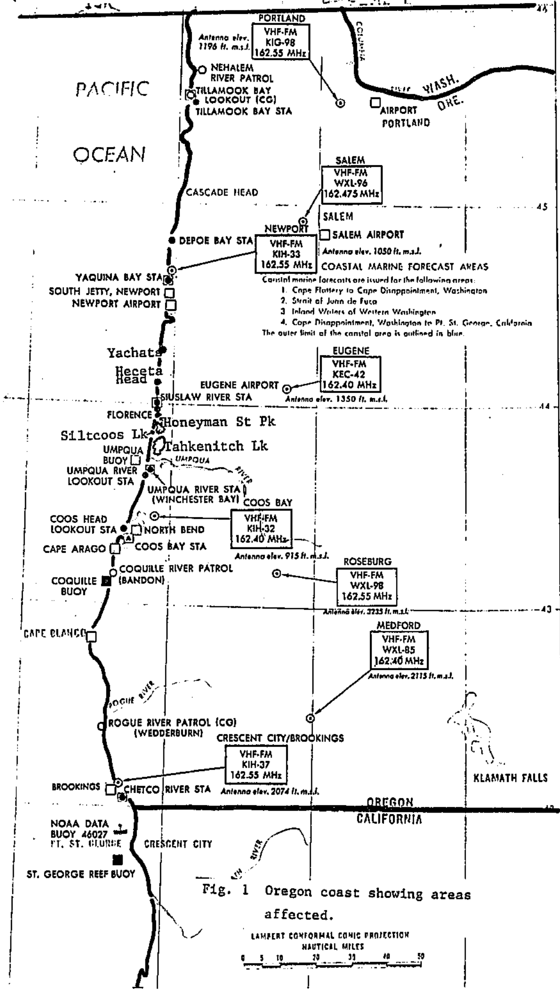

Fig. 1 Oregon coast showing areas affected.

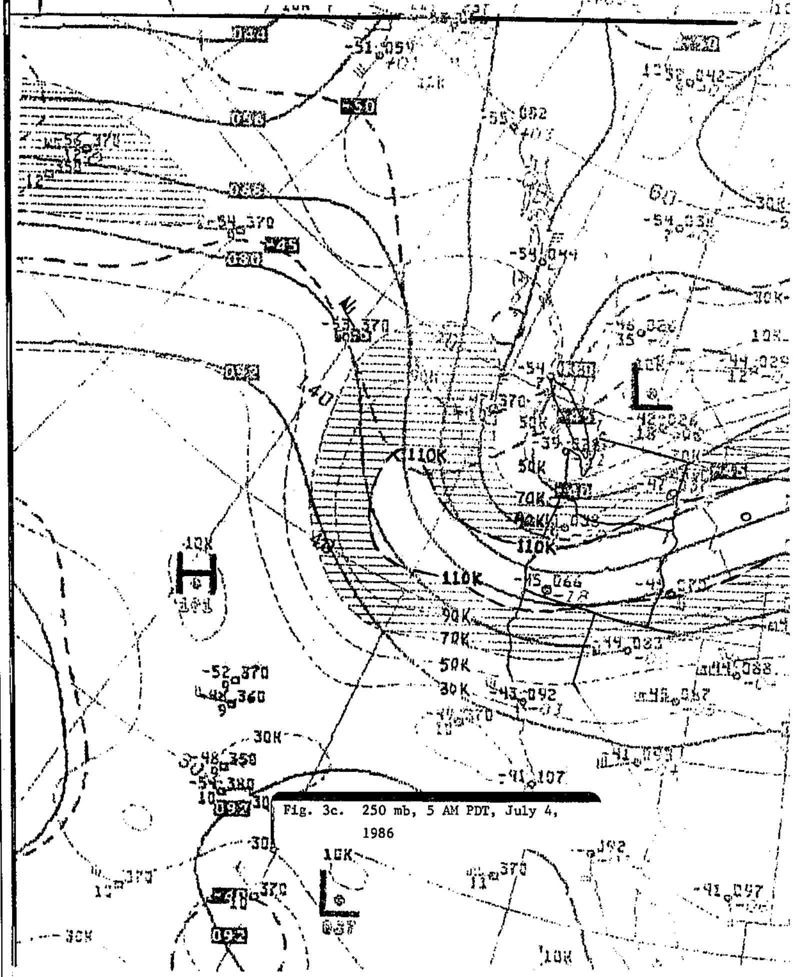

Fig. 3c. 250 mb, 5 AM PDT, July 4, 1986

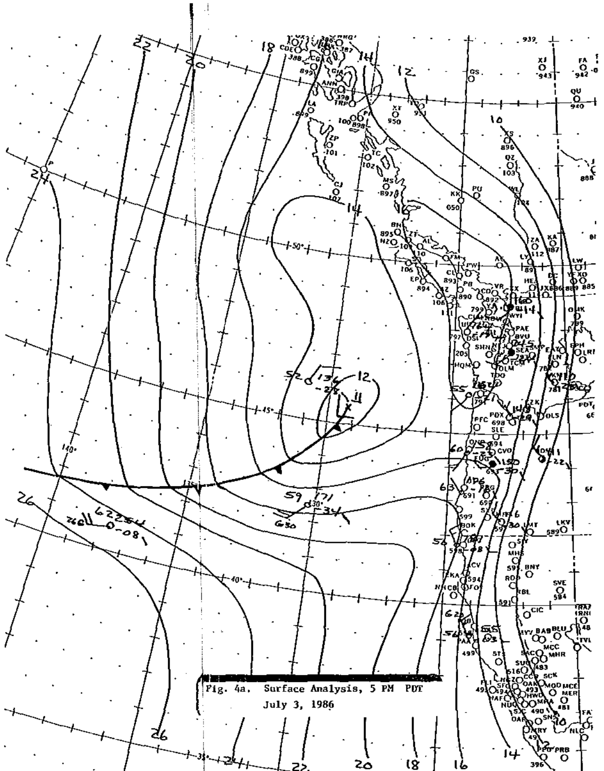

Fig. 4a. Surface Analysis, 5 PM PDT
July 3, 1986

0000Z July 4, 1986

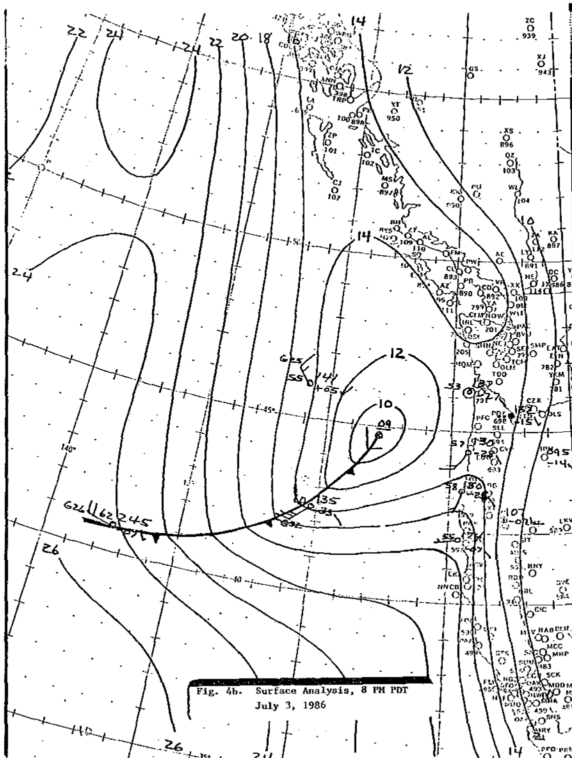

Fig. 4b. Surface Analysis, 8 PM PDT
July 3, 1986

0300Z July 4, 1986

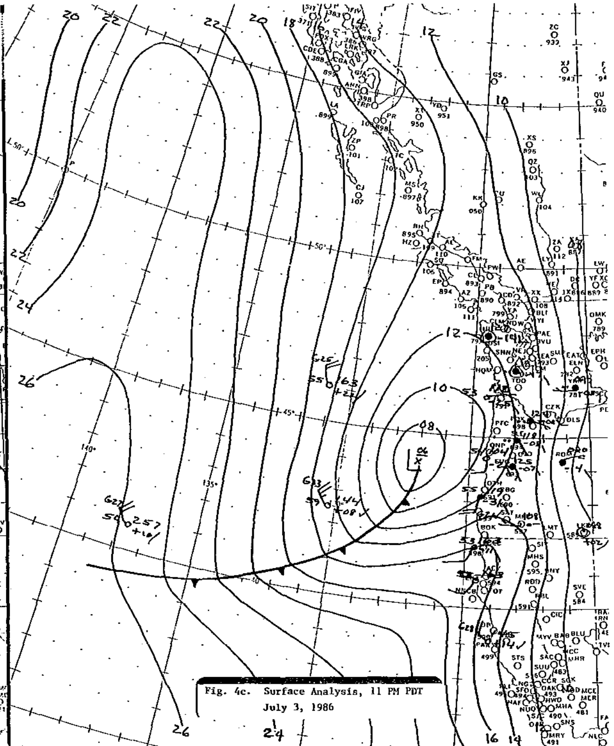

Fig. 4c. Surface Analysis, 11 PM PDT
July 3, 1986

0600Z July 4, 1986

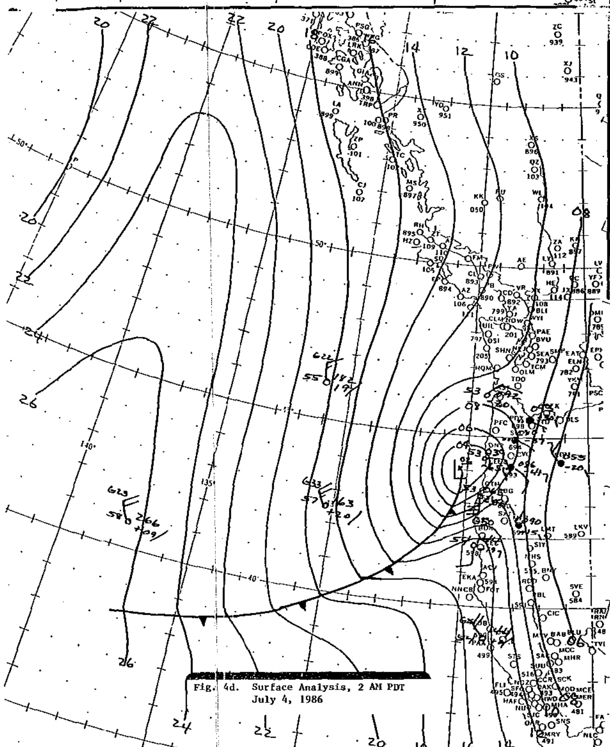

Fig. 4d. Surface Analysis, 2 AM PDT
July 4, 1986

0900Z July 4, 1986

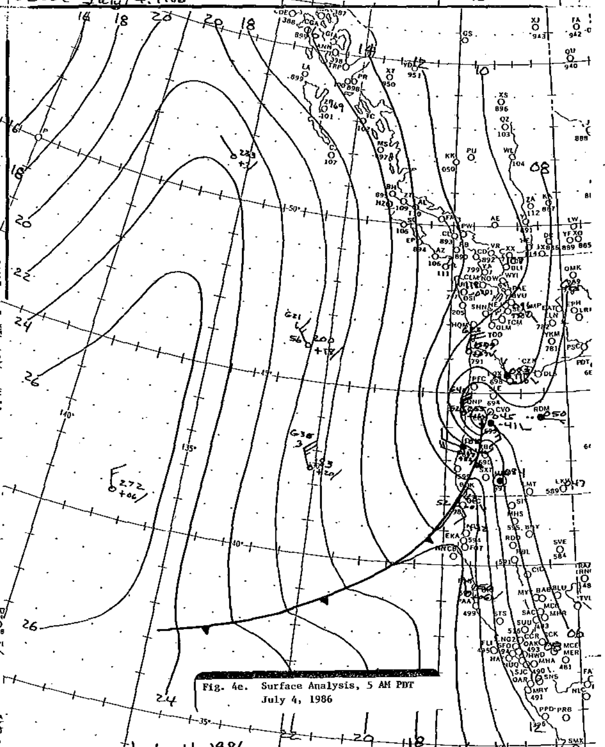

Fig. 4e. Surface Analysis, 5 AM PDT
July 4, 1986

1200Z July 4, 1986

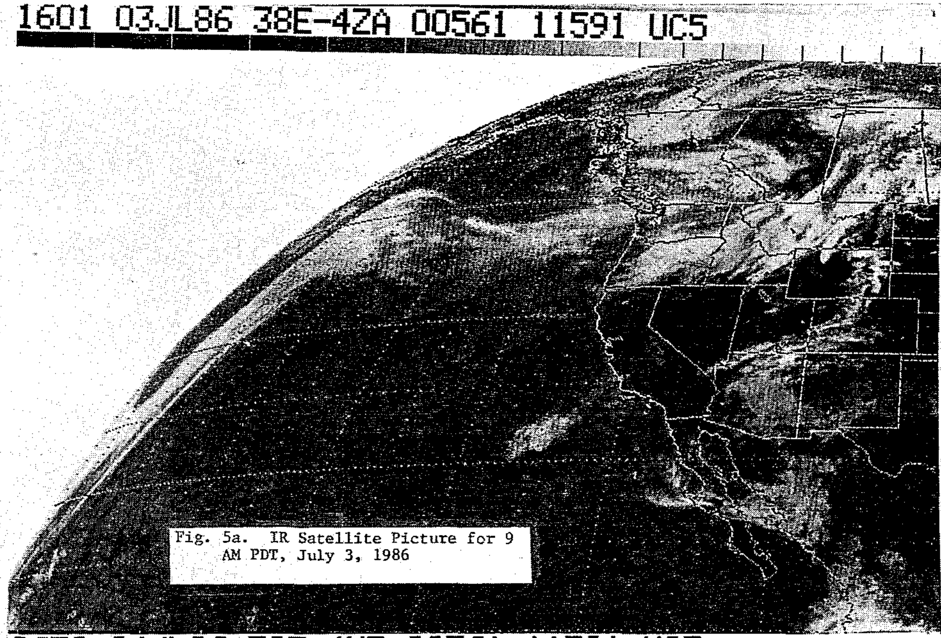

Fig. 5a. IR Satellite Picture for 9 AM PDT, July 3, 1986

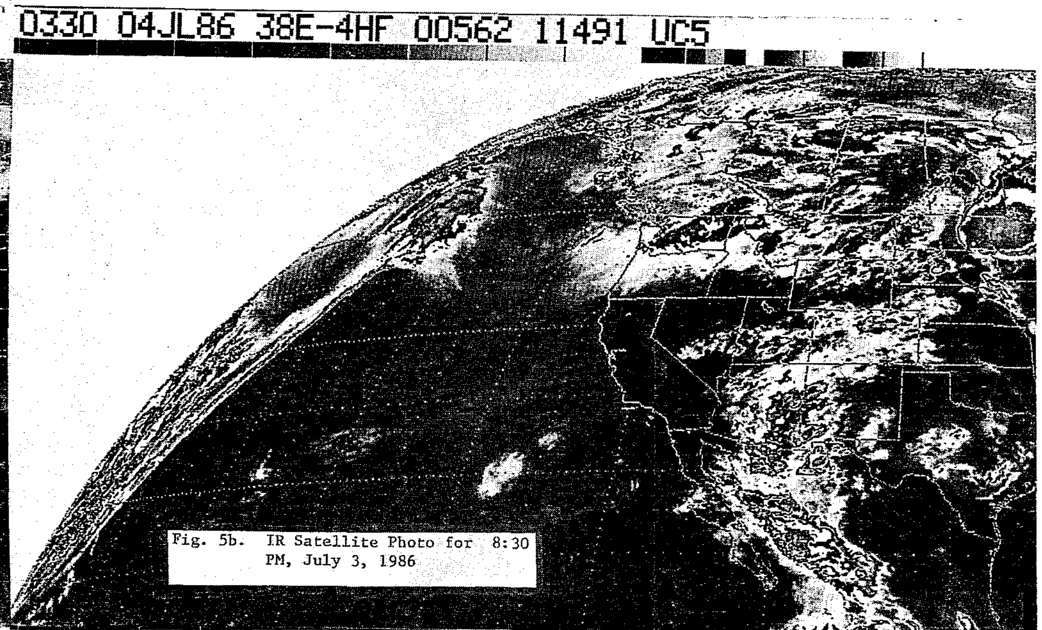

Fig. 5b. IR Satellite Photo for 8:30 PM, July 3, 1986

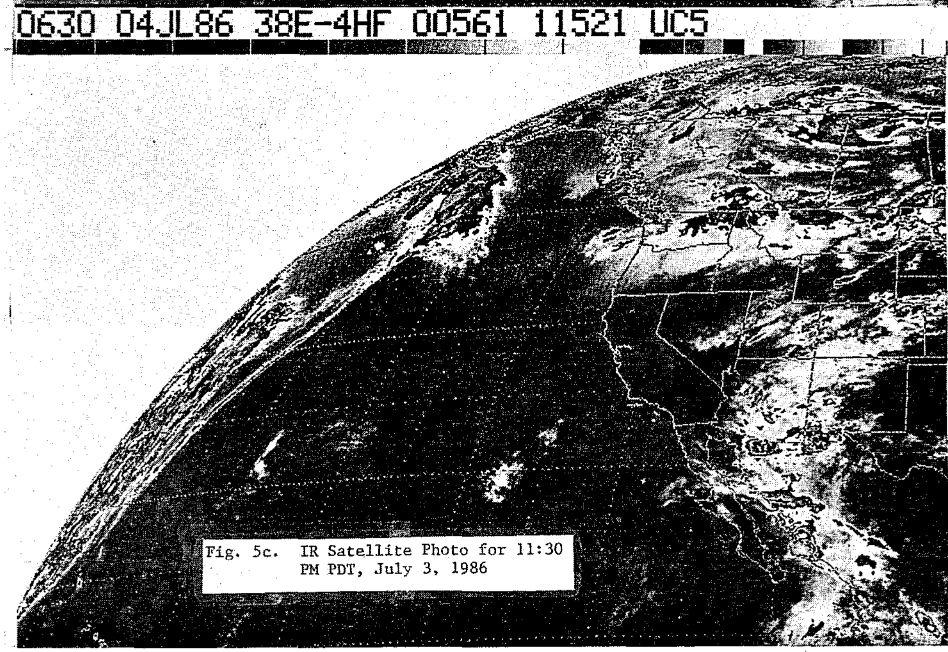

Fig. 5c. IR Satellite Photo for 11:30 PM PDT, July 3, 1986

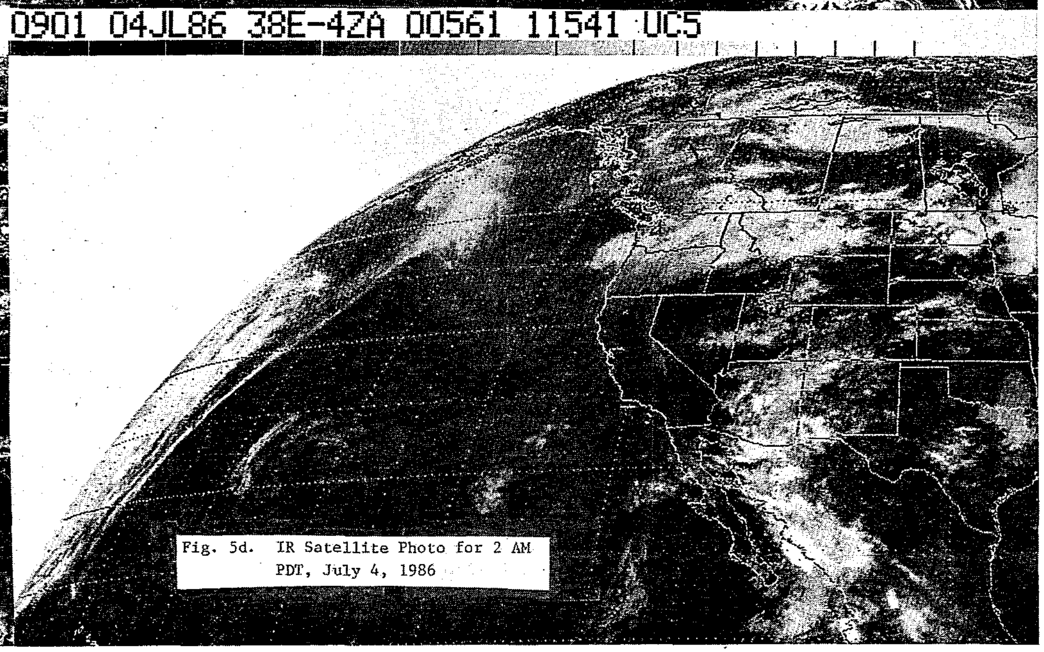

Fig. 5d. IR Satellite Photo for 2 AM PDT, July 4, 1986

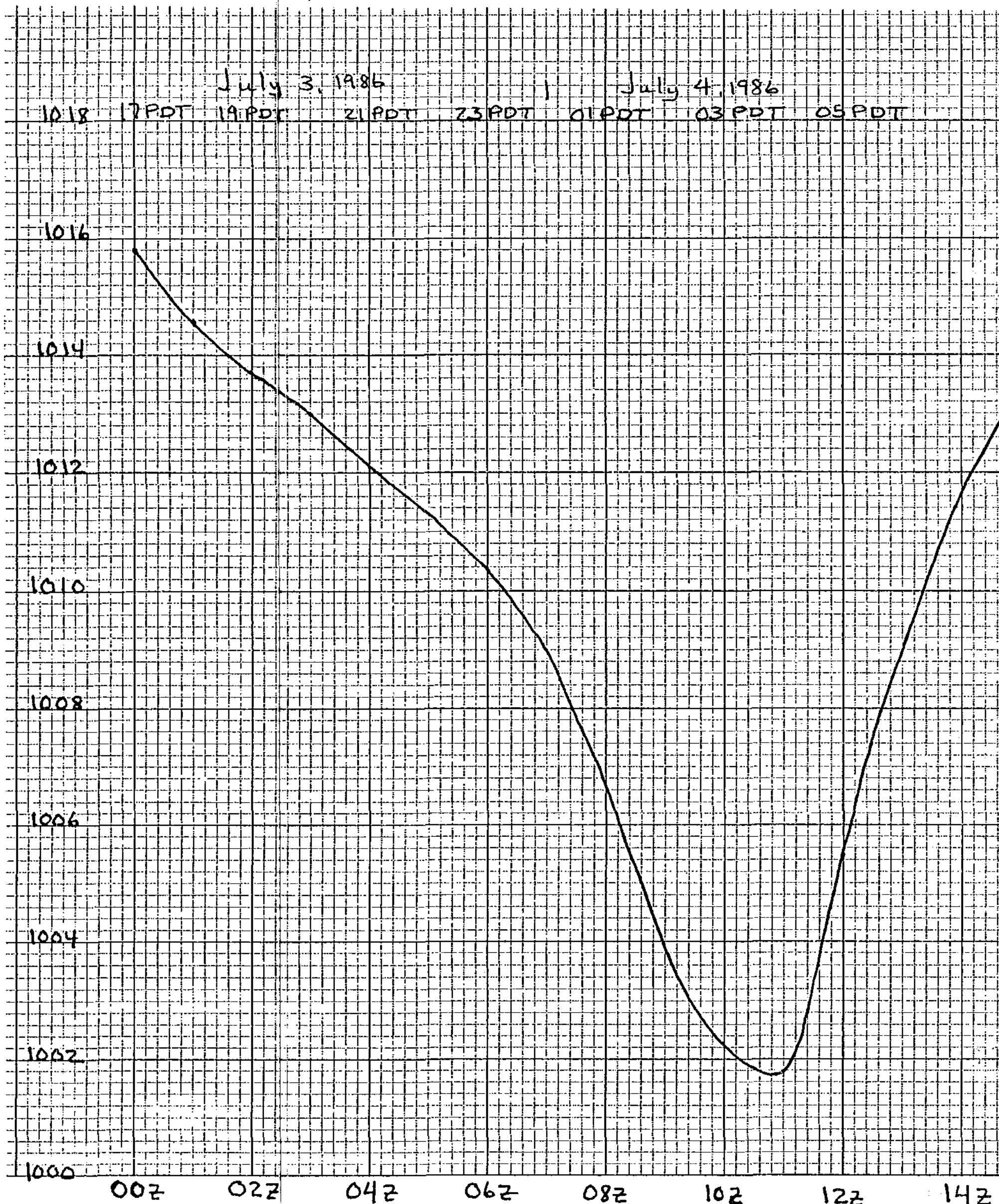

Fig. 6. Sea Level Pressure vs. Time at Newport C-MAN Station

4 July 1986

Jetty)

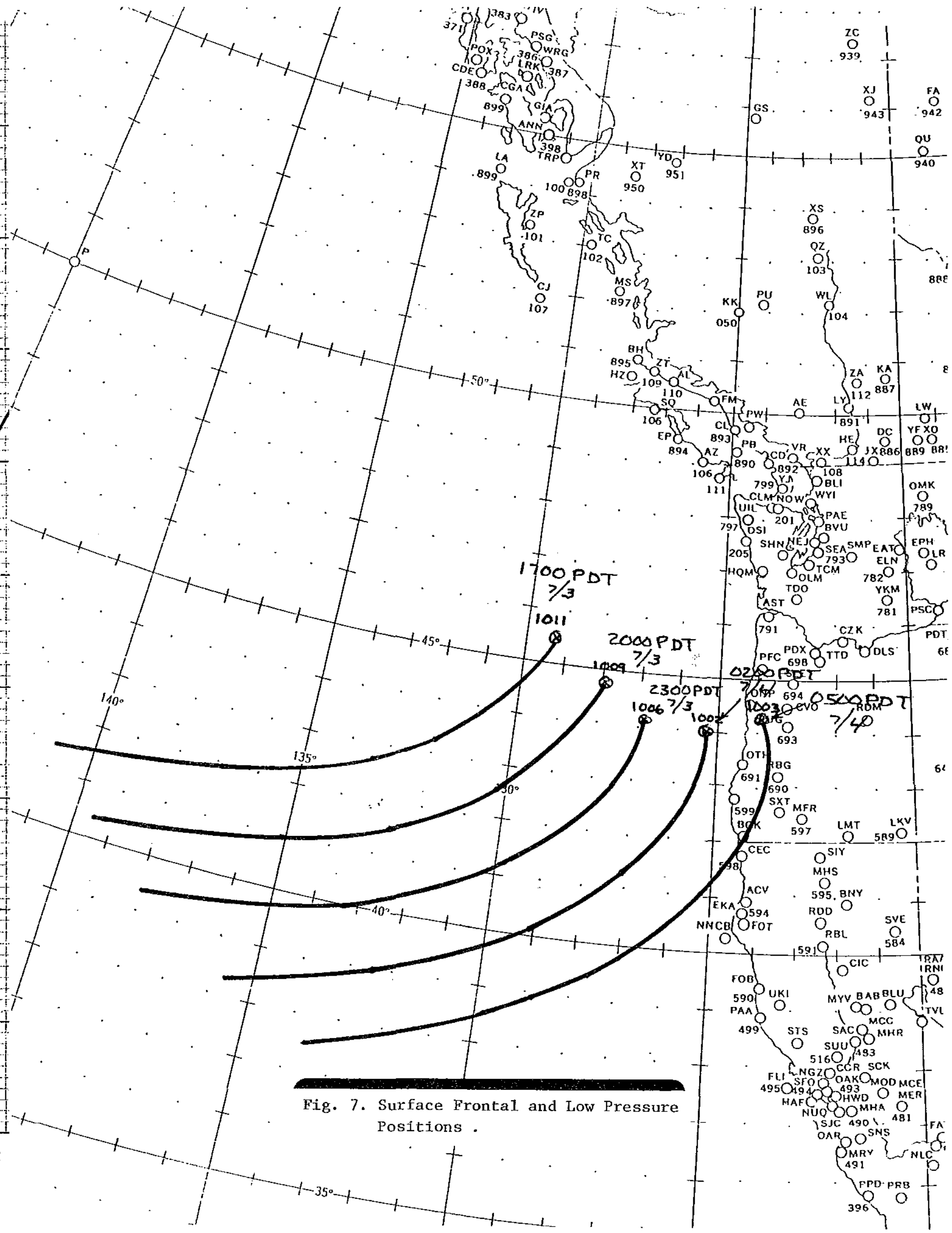

Fig. 7. Surface Frontal and Low Pressure Positions .

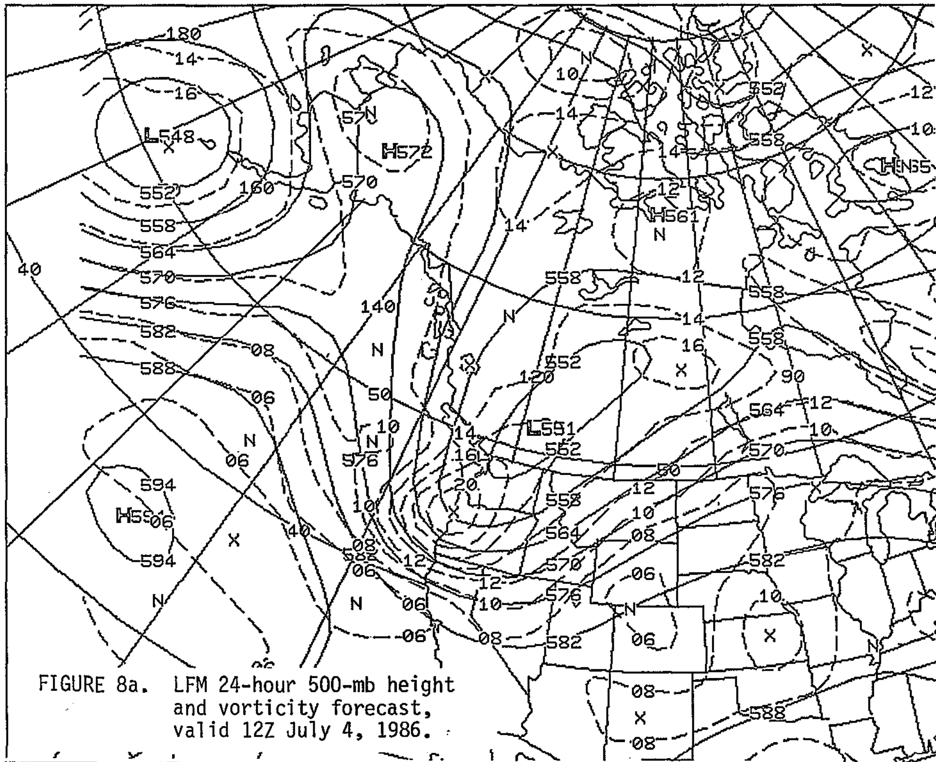

FIGURE 8a. LFM 24-hour 500-mb height and vorticity forecast, valid 12Z July 4, 1986.

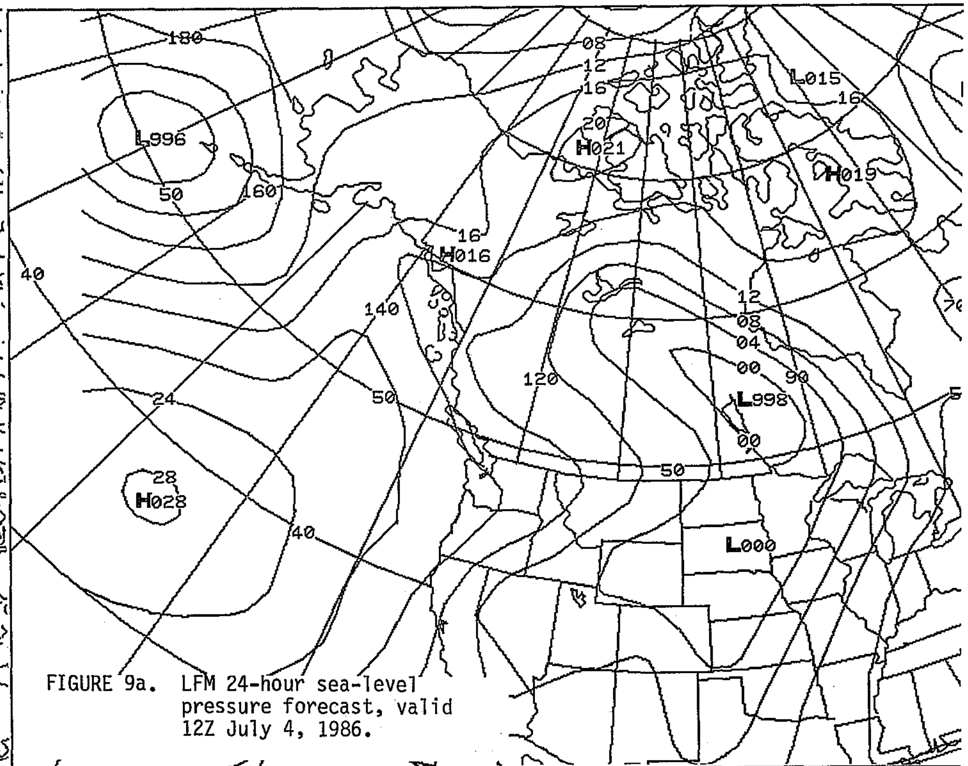

FIGURE 9a. LFM 24-hour sea-level pressure forecast, valid 12Z July 4, 1986.

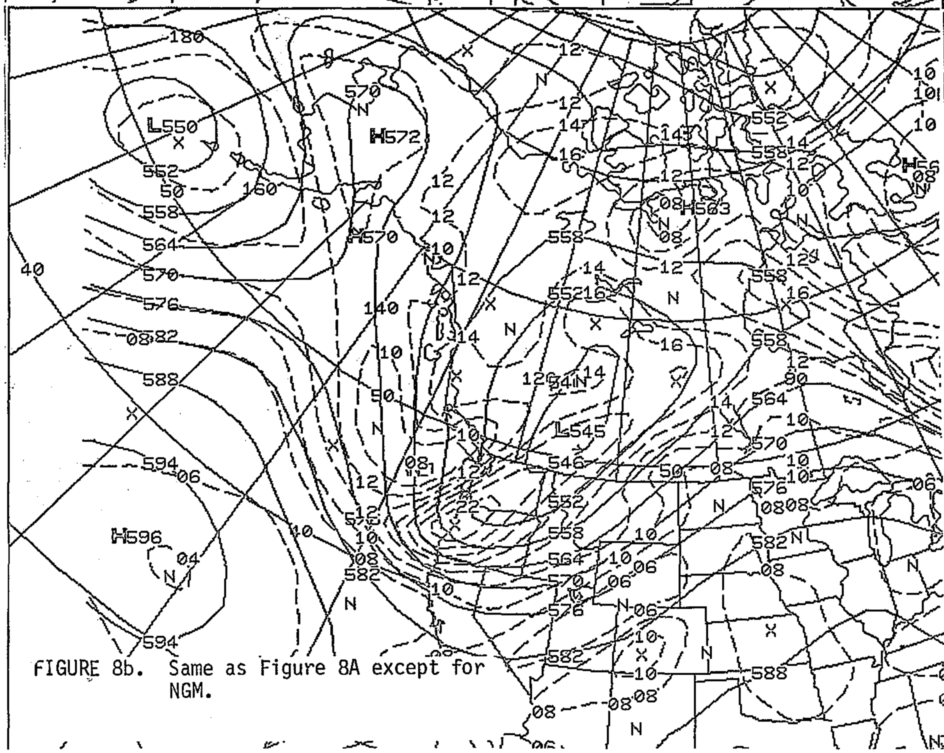

FIGURE 8b. Same as Figure 8A except for NGM.

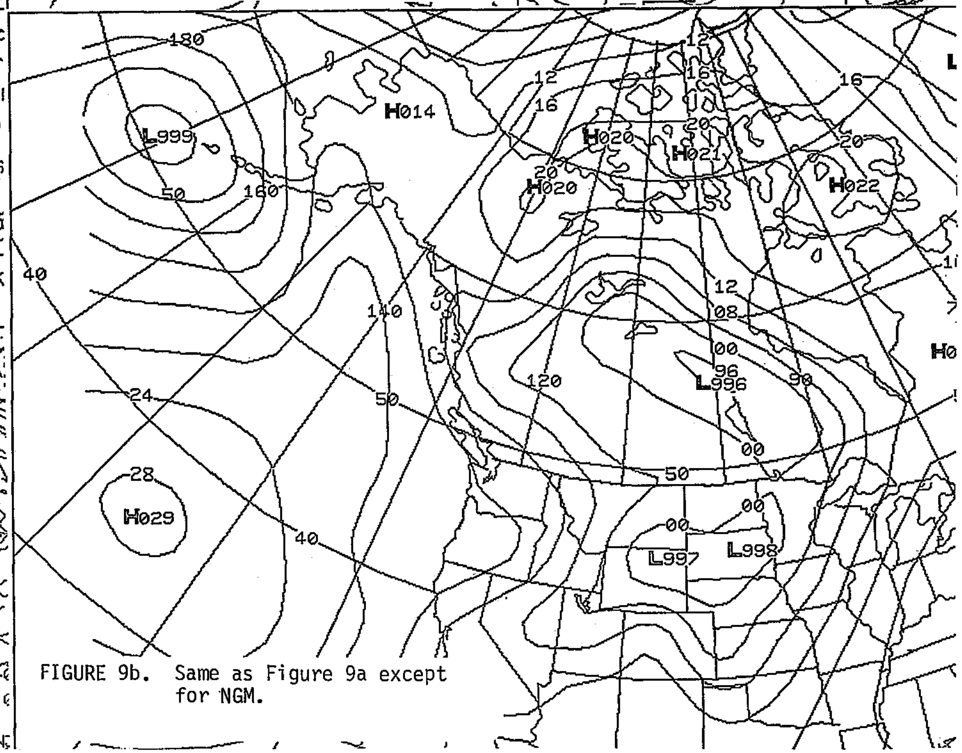

FIGURE 9b. Same as Figure 9a except for NGM.

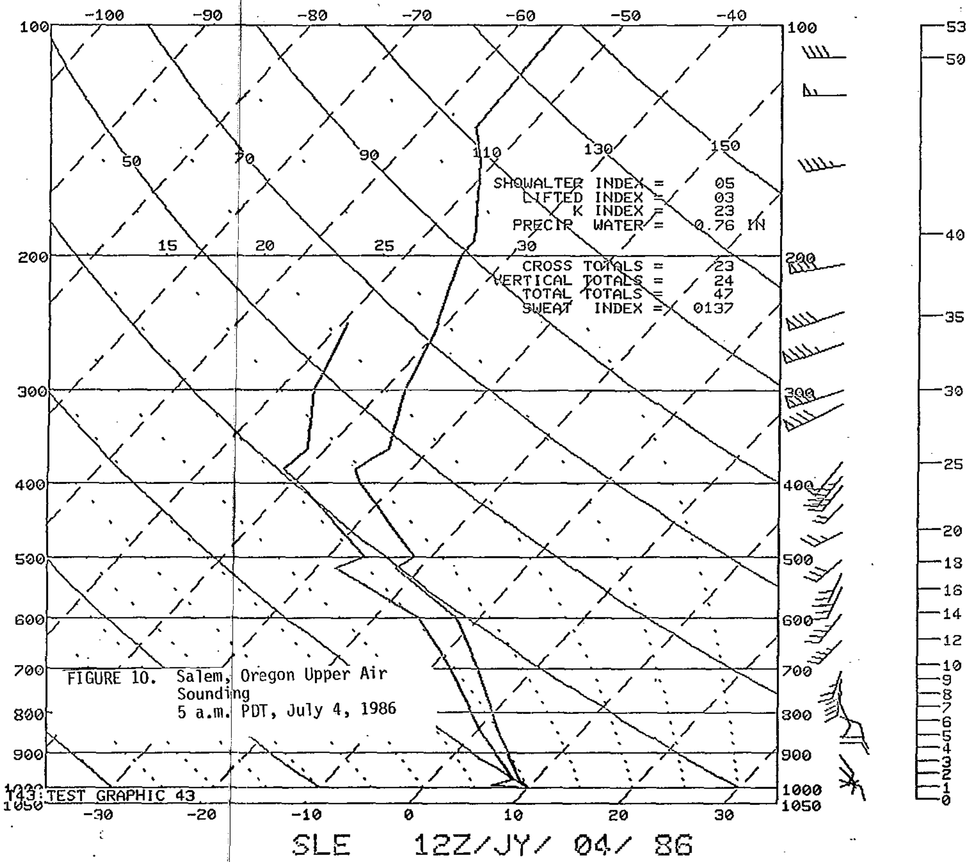

FIGURE 10. Salem, Oregon Upper Air Sounding 5 a.m. PDT, July 4, 1986

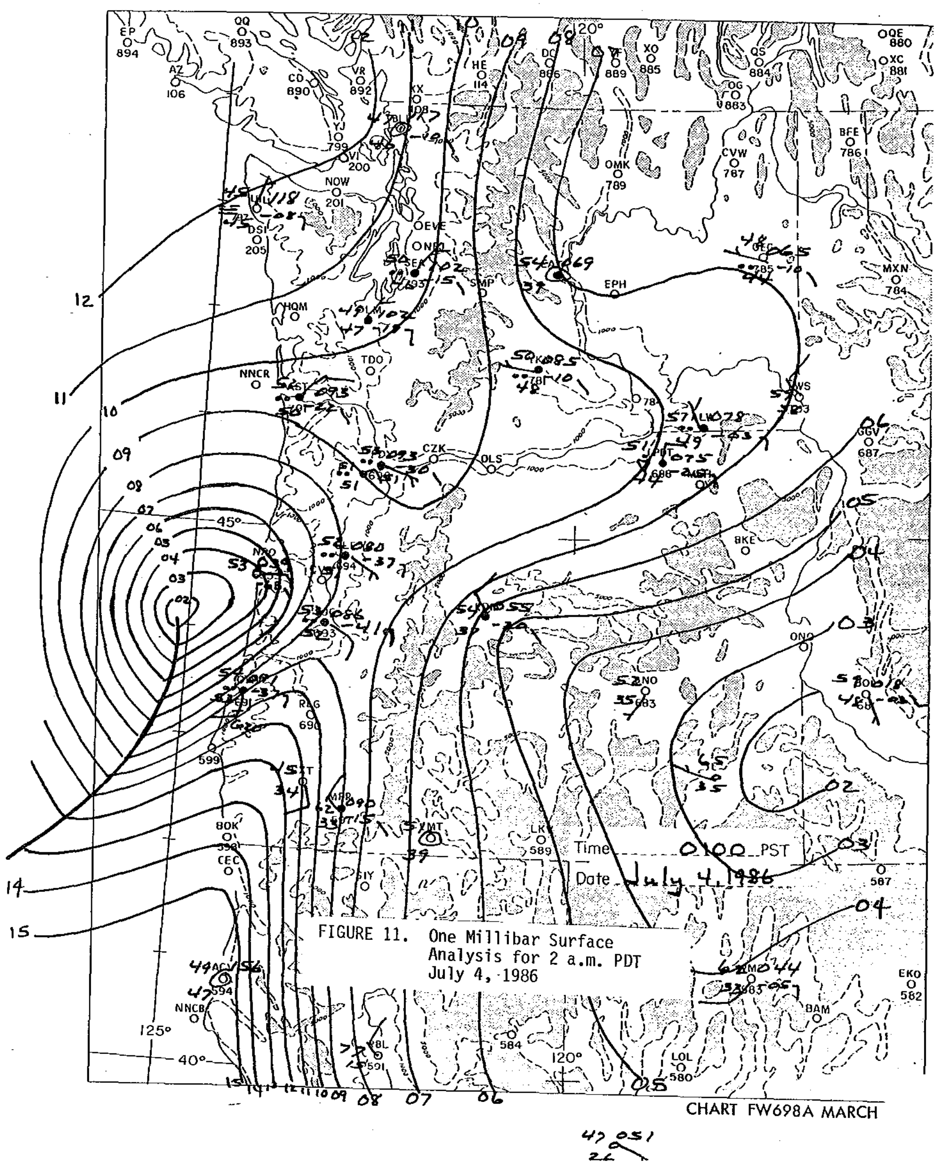

FIGURE 11. One Millibar Surface Analysis for 2 a.m. PDT July 4, 1986