



**Western Region Technical Attachment  
No. 90-42  
December 11, 1990**

**A VERIFICATION STUDY  
OF THE NMC 3-5 DAY FORECAST PRODUCT USING  
THE ANCHORAGE WSFO SURFACE ANALYSIS**

**Gregory E. Matzen, WSO Wenatchee**

**PURPOSE**

The purpose of this Technical Attachment is to assess biases in the 3-5 Day NMC Mean Sea Level Pressure Forecast product in forecasting intensities and locations of lows across the North Pacific and the Bering Sea. The 12Z Anchorage WSFO surface analyses were used to verify the forecast product during the winter season, from September 1988 through February 1989.

**DESCRIPTION OF THE 3-5 DAY NMC PRODUCT**

The daily NMC 3-5 Day Forecast product is manually prepared by modifying numerical weather prediction model guidance generated from 00Z initial data. The mean sea level pressure charts are valid for forecast days 3, 4, and 5. The forecast product also contains a 108-hour, waves 0-5 500 mb chart.

Subjective procedures are part of the daily product development. These are governed by the guidance and experience level of the NMC forecasters. Adjustments may be made to the location (speed), depth (intensity), and track of the forecast lows. These adjustments are often made to correct for known systematic errors within the guidance systems. For a complete description of the NMC 3-5 Day Forecast product, please refer to FHB #1 revised 10/85.

**STANDARDS**

The following standards were established at the beginning of the study in order to evaluate the 3-5 Day NMC Forecast product (hereafter referred to as the "Product"):

1. Generally only low pressure areas with central pressures of less than 1000 mbs were verified.
2. The central pressures of lows depicted on the Product were set at the value of the central isobar minus one half the contour interval. For example, if the contour interval on a chart was 8 mbs and the closed isobar around the low "L" was 992 mbs, then the central pressure of the low was set at 988 mbs.

3. The positions of lows on each chart were set at the center of the closed isobar around each low. There were cases when more than one low was depicted inside an isobar. In these cases, one central location was usually selected. In cases where the adjacent isobar was not closed around a low, the low's position was selected at the base of the "L" on the chart.
4. The study encompassed most of the North Pacific extending eastward from 150E to 130W and northward from 38N to 65N. The study was generally confined to over-water areas, including the Bering Sea.
5. In cases where there were two or more forecast lows near each other and possibly two or more analyzed lows in the same area, the closest (analyzed/forecast) lows were selected without regard to intensities. Only nearby lows were compared. If an analyzed low was more than 20 degrees longitude or 15 degrees latitude from a forecast low, it was not included. This situation did not happen often, and the number of times was considered insignificant.
6. There were a total of 718 pairs of lows evaluated. Of course, many of these were the same analyzed lows across multiple 3-5 day periods.

Every attempt was made to evaluate the product fairly in every case during the 6-month study.

## EVALUATION

The evaluation of the Product took on two specific directions. One was to determine how well the Product forecast central pressures of lows at 3, 4, and 5 days out. The second was to determine how well the Product forecast movement of low centers during the 3-5 day period.

### 3-5 DAY CENTRAL-PRESSURE VERIFICATION

First, a month-by-month evaluation was undertaken to determine how well the Product did in forecasting low-pressure-center intensities. Figures 1-3 show how many times each month the Product was too deep or too weak in forecasting low-center pressures.

An inspection of the figures shows that for most months the Product tended to be biased toward under-forecasting the central pressures. The only significant exception was during the month of January 1989. This was true for all days of the 3-5 day period.

Table 1 depicts how deep or how weak the average forecast lows were as compared to analyzed lows for each day and each month.

TABLE 1

Average difference in millibars  
of Forecast Lows too Weak (W) or too Deep (D)

<u>Month</u>	<u>Day 3</u>		<u>Day 4</u>		<u>Day 5</u>	
	D	W	D	W	D	W
Sep 88	7	12	7	15	5	13
Oct 88	7	10	6	12	8	10
Nov 88	7	9	9	11	9	7
Dec 88	7	9	9	9	10	10
Jan 89	8	7	9	10	12	11
Feb 89	5	13	5	11	10	13
Season	6.8	10.0	7.5	11.3	9.0	10.7

Notice how the Product is biased toward under-forecasting the lows by a greater average for most days and months.

Figures 4-6 show only the numbers of lows for each month when forecast/analyzed central pressures differed by 10 mbs or more. A similar weak bias shows up. Note the significant number of lows under-forecast by 10 mbs or more for each day and for every month but January.

Table 2 shows the percentage of Product lows that were forecast 10 mbs or more too weak or too deep for each month and forecast day. For example 55% of the forecast lows on Day 5, in September, were under-forecast by 10 mbs or more.

TABLE 2

Percent of Lows Forecast  
too Weak (W) or too Deep (D) by 10 mbs or More

<u>Month</u>	<u>Day 3</u>		<u>Day 4</u>		<u>Day 5</u>	
	W	D	W	D	W	D
Sep 88	41	9	47	16	55	5
Oct 88	23	9	30	9	27	20
Nov 88	26	10	23	19	17	14
Dec 88	31	8	31	7	35	24
Jan 89	9	23	16	24	22	30
Feb 89	31	8	24	9	33	20
Season	26	11	29	14	32	19

The bias of the Product in forecasting a larger percentage of lows too weak versus too deep is evident. This was true for all months and forecast days except January 1989.

## DEVIATION IN POSITION OF ANALYZED LOW FROM FORECAST LOW

The second evaluation of the Product was a determination of how well the Product forecast low-pressure center locations 3 to 5 days out.

Figures 7-9 show the numbers of lows the Product forecast in a particular direction from nearby analyzed lows, broken down according to intensity error.

A close inspection of Figs. 7-9 reveals two biases. The first is the Product forecasts more lows weaker versus deeper than analyzed lows for all sectors except northwest (NW). The second is the Product forecasts low positions more often "north" (NW-NE) of actual analyzed positions than "south" (SW-SE) of analyzed positions. This occurred most often with the Day 5 chart. See Table 3.

TABLE 3

A Direction Comparison  
(Numbers of Lows)

	<u>NW and NE Sectors</u>	<u>SW and SE Sectors</u>
Day 3	135	116
Day 4	127	111
Day 5	126	103

Figure 10 compares directions only of all Product lows to analyzed lows. Again, the bias toward forecasting a greater number of lows too far northwest through northeast of actual, analyzed lows is evident.

### CONCLUSION

The overall accuracy of the 3-5 Day NMC Forecasts, during the period from September 1988 through February 1989, was reasonably good.

Summarizing the results of this study revealed two particular biases worth noting: (1) The bias of the Product to forecast (track) lows too often northwest through northeast of their actual positions; and (2) The bias of the Product to forecast lows too weak more often than too deep. Although difficult to explain, the data from January 1989 (a cold, record-breaking month for Alaska) are not consistent with these overall biases.

It is well known that numerical guidance tends to under intensify central pressures of lows (Sanders, 1987) as well as to track lows to the right of their actual movement. This study shows that the subjective procedures of forecasters at NMC to adjust the intensity and track of forecast lows may need to be fine-tuned.

### REFERENCE

Sanders, F, 1987: Skill of NMC Operational Dynamical Models in Prediction of Explosive Cyclogenesis, *Weather and Forecasting*, 2, 322-336.

# 3-DAY PROG COMPARISON

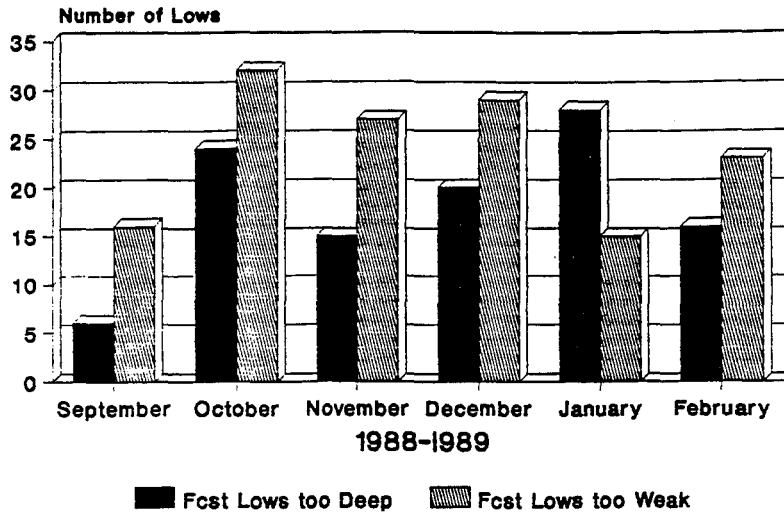


Figure 1

# 4-DAY PROG COMPARISON

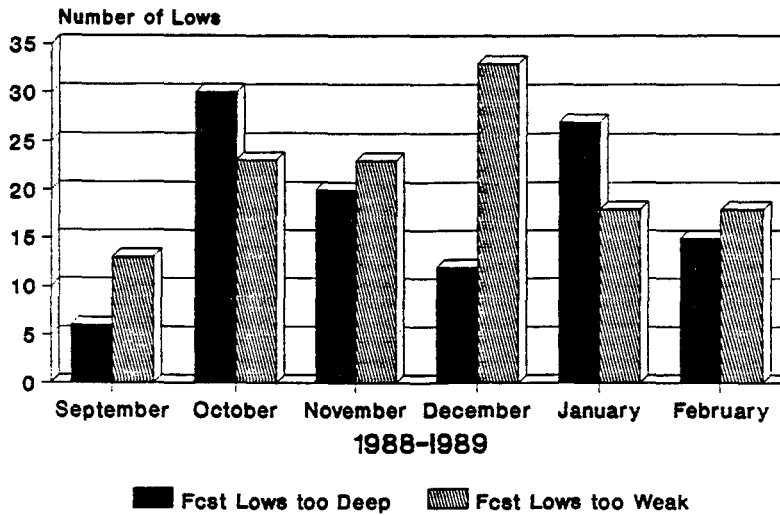


Figure 2

# 5-DAY PROG COMPARISON

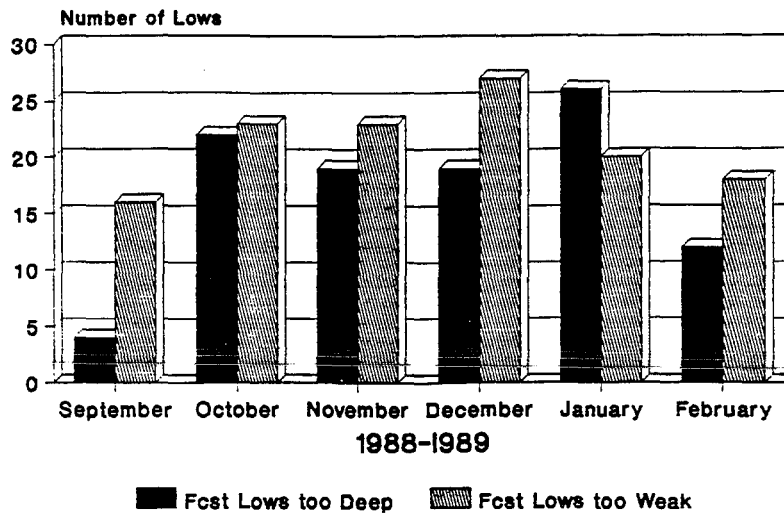


Figure 3

# 3-DAY PROG COMPARISON

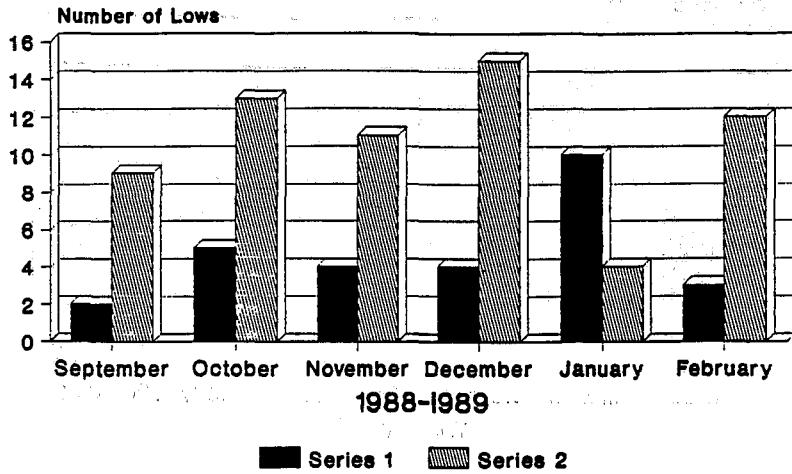


Figure 4. Series 1 depicts Fcst Lows 10MB or more too Deep. Series 2 depicts Lows 10MB or more too Weak.

# 4-DAY PROG COMPARISON

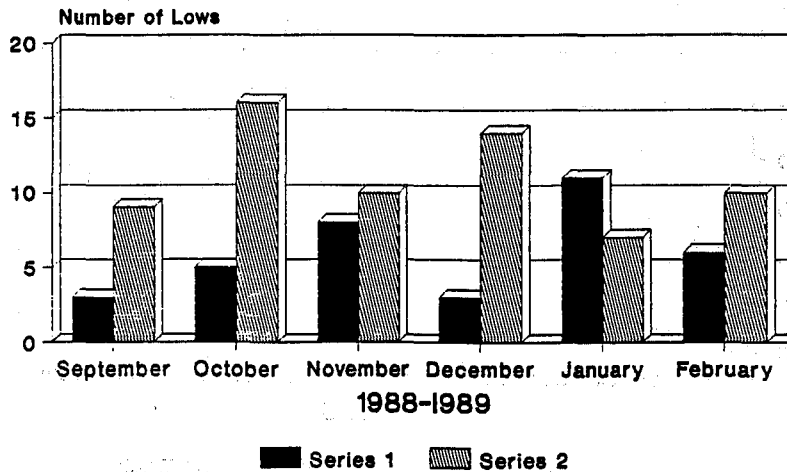


Figure 5. Series 1 Depicts Fcst Lows 10MB or more too Deep. Series 2 depicts Lows 10MB or more too Weak.

# 5-DAY PROG COMPARISON

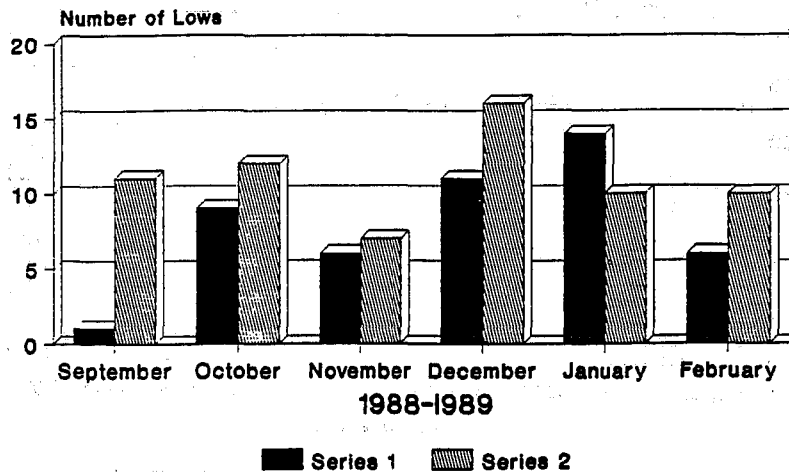


Figure 6. Series 1 depicts Fcst Lows 10MB or more too Deep. Series 2 depicts Lows 10MB or more too Weak.

### 3-DAY PROG COMPARISON

September 1988 - February 1989

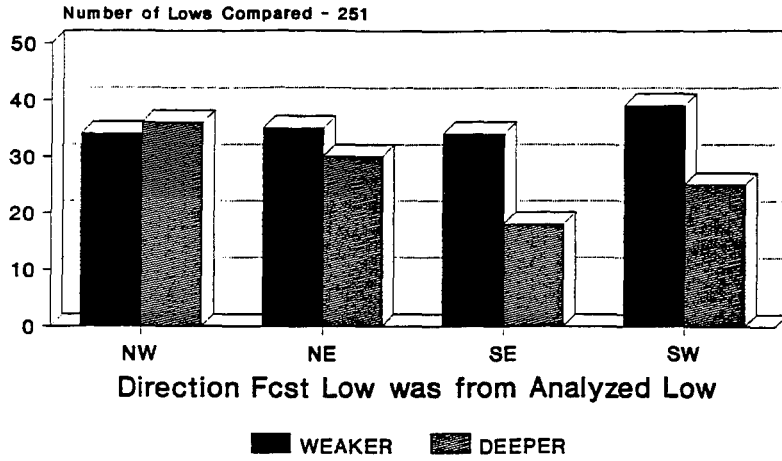


Figure 7. Compares Fcst Lows to Analyzed Lows.

### 4-DAY PROG COMPARISON

September 1988 - February 1989

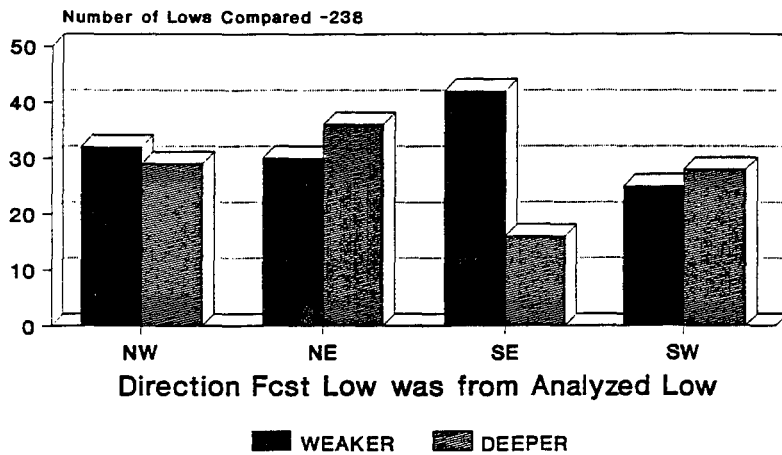


Figure 8. Compares Fcst Lows to Analyzed Lows.

### 5-DAY PROG COMPARISON

September 1988 - February 1989

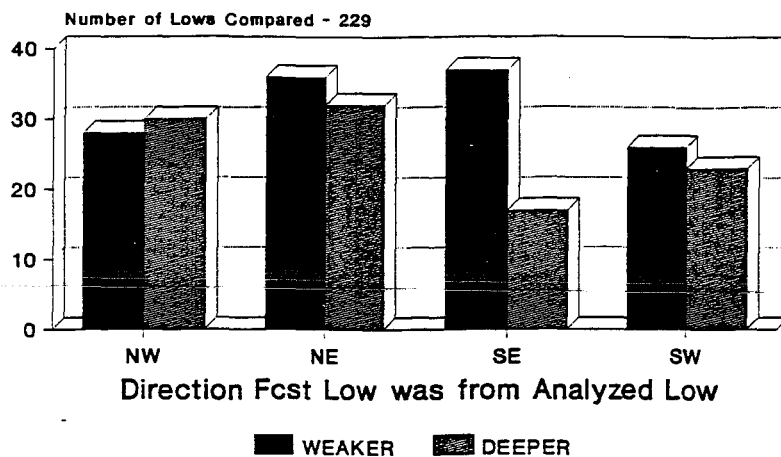


Figure 9. Compares Fcst Lows to Analyzed Lows.

# ALL-DAYS PROG COMPARISON

September 1988 - February 1989

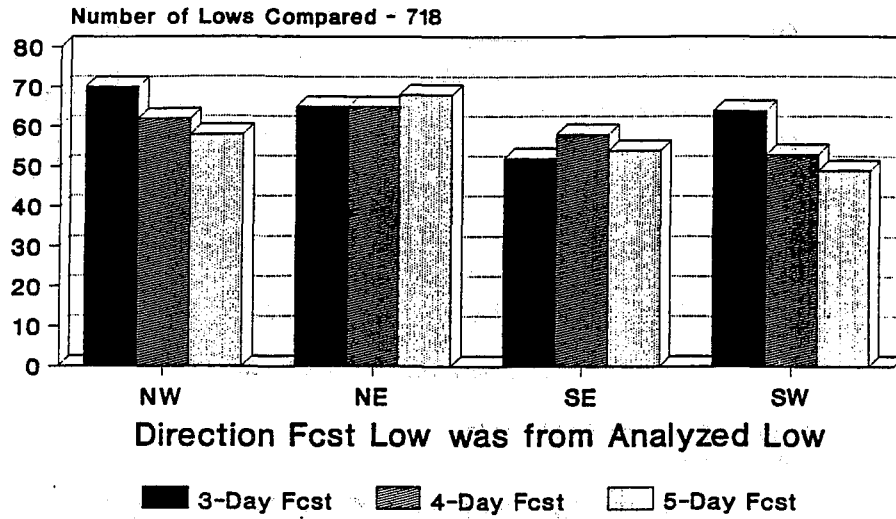


Figure 10. Compares Direction only of all Fcst Lows to Analyzed Lows.