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COMPARING VERIFICATION STATISTICS OF A WSO AND WSFO

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1. Overview

A verification program was initiated at WSO Lander, Wyoming in April of 1987. The overall purpose of the program was to identify the strengths and weaknesses of forecasting from a WSFO as compared to adaptive forecasting "on location" at a WSO in the first period (12 hours) of the forecast. Indirectly, the program looked at the effects on forecast performance at the WSFO with enhanced technology and data base versus the limited technology and data base available at the WSO's. With the advent of the Enhanced Local Forecast Program in the Central Region, it was particularly important to examine these aspects of the weather service program in Wyoming at this time.

To accomplish the tasks mentioned above, the verification program needed to do the following:

1. Provide quantitative feedback to the WSO staff on individual and station forecast performance.

2. Compare the forecast performance of WSO in the local forecast with the forecast performance of the WSFO.

2. Methodology

The verification program that was initiated at WSO Lander was a scaled down program of the manual forecast verification program already established at WSFO Cheyenne. This manual verification program complements the national verification program at WSFO Cheyenne. Temperature and precipitation forecasts were

verified in a manner similar to the national verification program. Temperature forecasts utilize an "improvement over MOS" technique

SCORE = (MOS - ACTUAL) - (FCST T - ACTUAL)

where MOS represented the computer forecast and FCST T represented the human forecast. Scores were computed for both maximum and minimum temperature twice each period, once for the WSO forecaster and once for the WSFO forecaster. Since all scores were computed in relation to MOS, a score of 0 indicated no improvement over the MOS forecast, with positive numbers representing an improvement over MOS. Similarly, negative numbers represented a more accurate MOS forecast.

Precipitation forecasts were verified by using a modified Brier Score:

$$\text{SCORE} = (\text{HIT/MISS} - \text{MOS POP})^2 - (\text{HIT/MISS} - \text{FCST POP})^2$$

where MOS POP represented the computer forecasted probability of precipitation and FCST POP represented the station input. The other component of the equation, either a hit or a miss (HIT/MISS), represented two constants which had the values 0 and 10. The score was determined by using one of these two values, depending upon which of the following conditions was met:

1. Use "10" if .01" or more of precipitation was measured in the period. This was considered a "HIT."

2. Use "0" if only a trace or no precipitation was measured. This was considered a "MISS."

Tables could easily be developed from the precipitation scores. Again, the resulting scores related the skill of the forecaster to that of MOS with positive numbers indicating an improvement over MOS, and negative numbers representing a more accurate MOS forecast.

3. Procedures

Temperature and precipitation forecasts were made twice each day at the WSO in the early morning and late, late afternoon. The valid period for minimum temperatures was 02Z-15Z (7:00 p.m. - 8:00 a.m. first). The valid period for maximum temperatures was 15Z-02Z (8:00 a.m. - 7:00 p.m. first). Similarly, precipitation forecast valid periods were 12Z-00Z and 00Z-12Z which were termed the morning and afternoon forecast for daytime and nighttime precipitation, respectively. Temperature and POP data for the forecast office was taken from the coded cities forecast (CYSCCFCYS) at 3:00 a.m. and 3:00 p.m. MST.

The verification program at the WSO considered only first period data (12 hours) where the WSO had its most authority in the forecast. The advantage of this simple verification system meant that statistics could be generated manually on a daily basis and more elaborately at the end of the month for more formal documentation.

In effect, manually generated daily statistics forced the individual at the WSO to look at their performance versus actual values, MOS values, and WSFO forecasted values. As a result, trends and biases could be easily seen and taken advantage of for the adaptive forecast issued. Computer generated statistics at the end of the month could also identify overall station and individual trends at the WSO and forecast office which proved enlightening.

4. Initial Results

WSO Lander is a full time WSO in west-central Wyoming located next to the Wind River Mountains. The WSO has a Remote Terminal for AFOS (RTA) system, NAFAX facsimile charts, and a RADID radar display system. WSO Lander is also an upper air site. WSFO Cheyenne, on the other hand, has AFOS with its extensive data base and the SWIS satellite imagery system.

Figure 1 depicts the results of the maximum temperature scores from the verification program. Most obvious is the seasonal cycle where both Lander and Cheyenne out-perform MOS in the spring and fall, a time when the atmosphere is in seasonal adjustment. It is important to note that there was no significant differences between Cheyenne and Lander in this category. One would expect WSO Lander to out-perform WSFO Cheyenne in this category, since WSO Lander had the advantage to look at the morning (12Z) sounding before entering the verification data. But this was apparently not the case.

Figure 2 depicts the results of the minimum temperature scores. Unlike Figure 1, this graph suggests that WSFO Cheyenne may have out-performed WSO Lander in this category. However, upon further statistical testing, no significant difference could be noted in performance between WSO Lander and WSFO Cheyenne.

As for precipitation, more interesting statistics resulted. Figure 3 depicts the results of the daytime precipitation forecasts (12-00Z). WSO Lander clearly out-performed WSFO Cheyenne. In fact, during the 1987 summer convective season, WSO Lander, by having the advantage of reviewing the upper air sounding before issuing the forecast, more skill resulted in the adaptive forecast. However, the most noteworthy gains were made by WSO Lander during the autumn when widespread synoptic precipitation was observed. Two overwhelming factors were believed to contribute to these gains:

1. Lander's verification entry deadline was close to forecast valid time.

2. Continuous monitoring of the precipitation intensity by the observer at the WSFO.

Figure 4 shows the precipitation results for the nighttime period (00Z-12Z). But unlike the daytime forecasts, the results were inconclusive as to which office had the advantage.

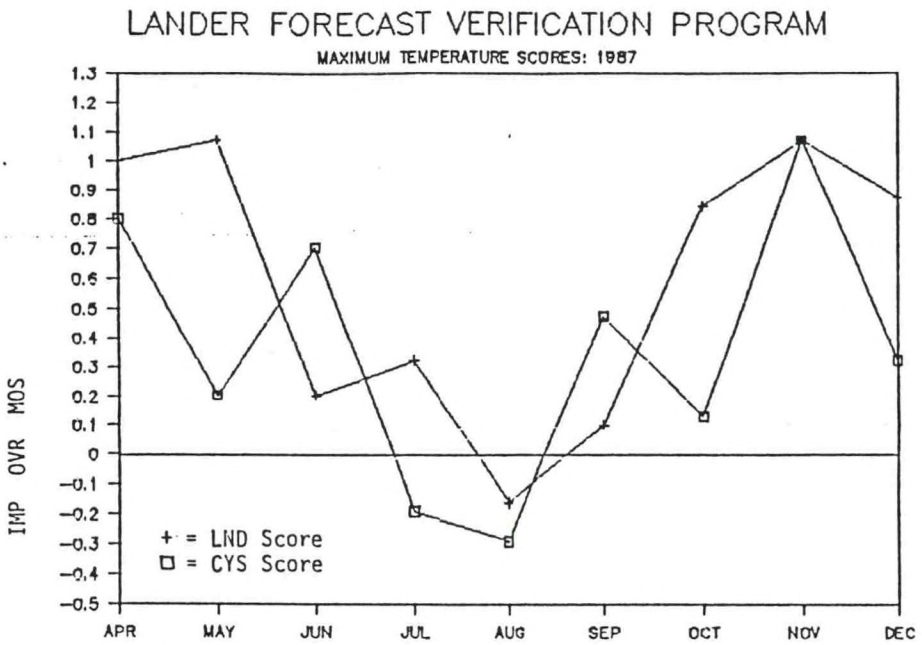

Figure 1.

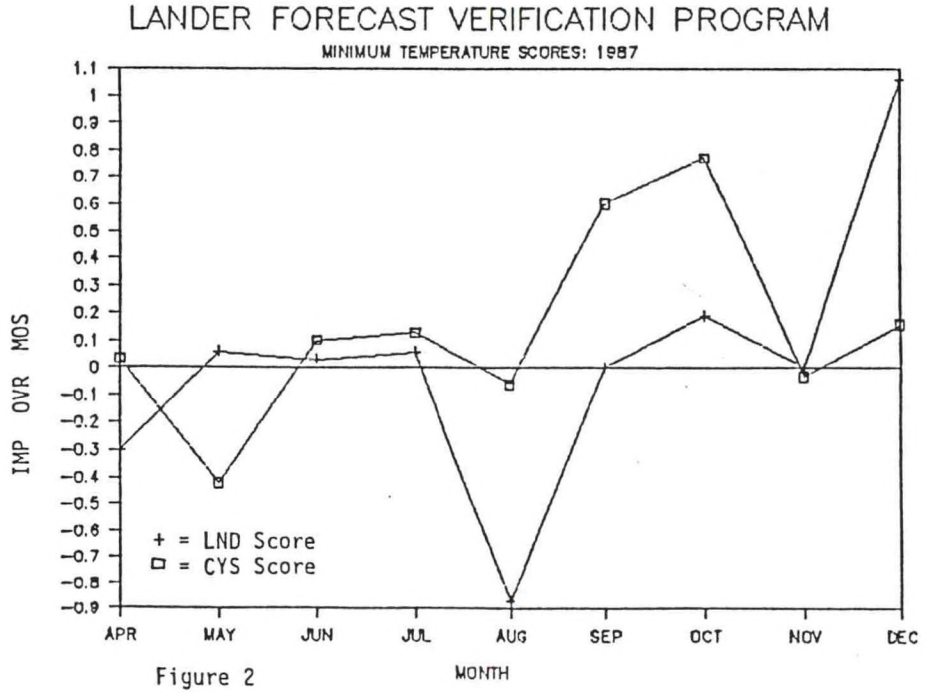

Figure 2

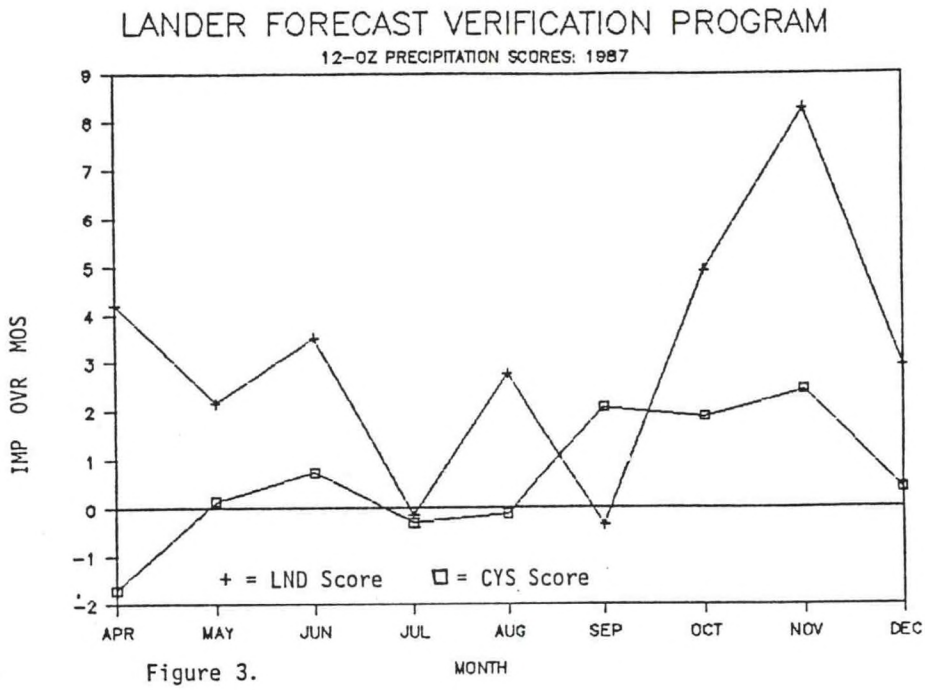

Figure 3.

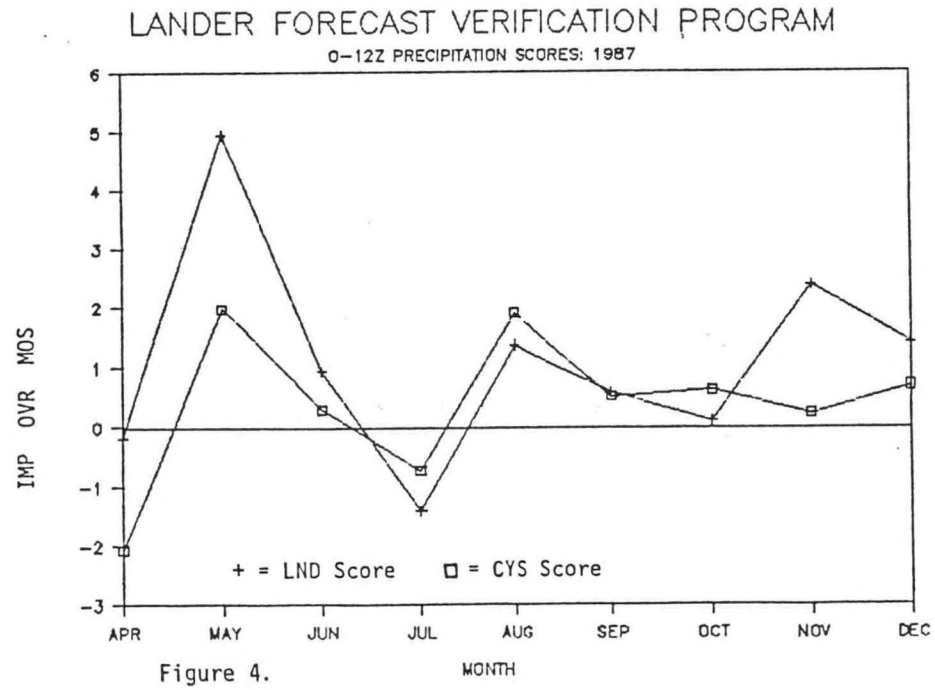

Figure 4.

4. Conclusions

Only for daytime precipitation did WSO Lander clearly out-perform WSFO Cheyenne (Figure 3). Although the other categories showed WSFO Cheyenne had out-performed Lander for minimum temperatures (Figure 2), and WSO Lander out-performed WSFO Cheyenne for nighttime precipitation (Figure 4), further statistical testing showed no significant difference between the offices' performance.

One item was strikingly apparent in the results. This was the inability of the WSO to significantly improve over the WSFO on first period verification statistics, even with the distinct advantage at the WSO of "looking out of the window." Thus, one could theorize that technological advances such as AFOS and SWIS have made an impact on the strict "numbers" of the verification program at the WSFO.

Care should be taken, however, as only two parameters were the source of these conclusions. The real benefit from the local forecast is in the wording and frequent updates which add an element of subjectivity to the forecast. A strict "numbers" verification program only measures a very small aspect of the total effectiveness of the adaptive forecast. Verification must also strike out into non-traditional parameters to be truly effective at the WSO.