Western Region Technical Attachment
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850 MB TEMPERATURE VERIFICATION OVER WASHINGTON STATE

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850 mb temperatures are used to forecast a variety of weather events across Washington State. In the winter, 850 mb temperatures are used to help determine if the precipitation will be liquid or frozen over western Washington. In the summer, 850 mb temperatures aid in forecasting daytime high temperatures in the higher elevations around the state such as the Cascade passes. 850 mb temperatures are also used as an aid to forecasting the high temperature at Spokane from late spring to early fall. A study was undertaken to evaluate how well the LFM and NGM models forecast 850 mb temperatures. Data verifying at 00Z was collected over a one year period from June 21, 1988 to June 20, 1989. 850 mb temperatures forecast were interpolated from AFOS graphics for the Quillayute (UIL) and Spokane (GEG) locations.

Table 1 shows the results of the verification in terms of percentage of the model runs too cold, within 1 degree C, and too warm. At Quillayute, the NGM outperformed the LFM every season in the 12, 24, and 36-hour forecasts with the exception of the 36-hour prog during the winter season. The LFM fared better on the 48-hour forecast, posting numbers comparable to the NGM during all but the summer season. At Spokane, the results were mixed. The 12-hour LFM during the spring and summer seasons had a significant cold bias with the average error being close to 4 degrees C, but during the fall and winter seasons the LFM performed as well as the NGM. The 24-hour progs were fairly even during all but the winter season where the LFM had an edge. The 36-hour forecasts showed quite similar results during the summer and fall seasons and, like the 24-hour progs, the LFM did better during the winter. The 36-hour LFM spring forecasts showed the same cold bias as the 12-hour forecasts during the spring and summer seasons with over 75% of the model runs being too cold. The NGM also exhibited a significant cold bias. As was the case at Quillayute, the LFM 48-hour forecast out-performed the NGM. Of the four seasons at Spokane, the LFM forecasts did better in three of the four seasons with the NGM doing slightly better during the fall season.

Figures 1 through 8 show the yearly totals of the individual model run errors. Although some of the seasonal trends are masked by the yearly totals, the stronger biases are still noticeable. (Example: 12-hour LFM at Spokane)

General Characteristics

A comparison of the models with respect to locations shows that both the LFM and the NGM generally performed better at Quillayute then at Spokane. These results are not unexpected since the 850 mb temperature changes tend to be greater inland than along the coast, away from the moderating influence of the marine air.

Taking a look at the models individually, the LFM tends to be too warm at Quillayute in all seasons as the forecast projection increases. In contrast, at Spokane the LFM has an increasing cold bias with time in the spring and summer, shows little bias in the winter, and is too warm in the fall. In addition, the LFM at Spokane has a strong cold bias during the spring and summer, especially with the 12-hour forecasts. This is likely due to the fact that the LFM has trouble resolving the diurnal heat cycle because of its deep boundary layer.

The NGM also shows a cold bias in the spring and summer at Spokane although not as pronounced as the LFM bias. The NGM at Spokane also shows a cold bias in the winter, but little bias in the fall. The NGM biases at Quillayute are not as extreme as the LFM, with the most notable being a warm bias in the summer and fall.

Conclusion

Model 850 mb temperature forecasts must be used carefully since large errors can occur, especially inland. While most forecast errors are within 3 degrees C, errors greater than 3 degrees C do occur often. However, the errors can be reduced if seasonal biases are applied before use, and the model 850 mb temperatures will be of greater utility. Further improvement may be possible if biases are examined according to similar synoptic situations or flow regimes.

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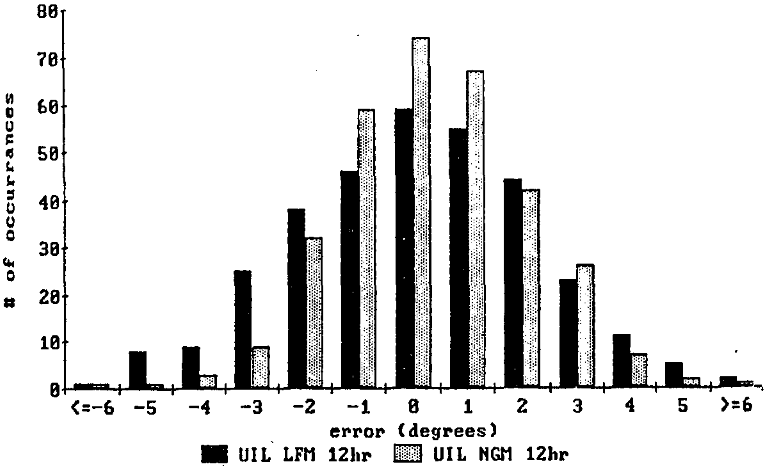
Table 1: Seasonal Results (in percent) too cold / within 1 degree C / too warm

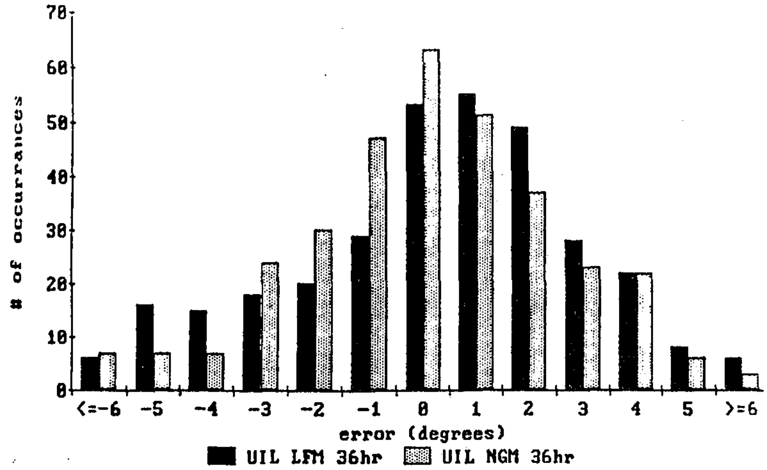
	Summer	Fall	Winter	Spring	Totals
UIL LFM 12hr	30/47/23	17/56/27	19/53/28	34/41/25	25/49/26
UIL NGM 12hr	18/56/26	10/68/22	19/57/24	9/67/24	14/62/24
UIL LFM 24hr	9/48/43	8/48/44	16/43/41	13/49/38	12/47/41
UIL NGM 24hr	17/55/28	11/61/28	18/51/31	33/53/14	30/53/17
UIL LFM 36hr	28/37/35	14/51/35	24/38/38	27/44/29	23/42/35
UIL NGM 36hr	18/50/32	19/54/27	31/37/32	24/56/20	23/49/28
UIL LFM 48hr	11/37/52	18/42/40	19/38/43	19/42/39	16/40/44
UIL NGM 48hr	21/52/27	26/41/33	34/35/31	36/39/25	29/42/29
GEG LFM 12hr	82/17/ 1	29/54/17	32/54/14	73/25/ 2	54/38/ 8
GEG NGM 12hr	35/52/13	21/55/24	31/51/18	33/53/14	30/53/17
GEG LFM 24hr	29/55/16	6/45/49	20/50/30	46/44/10	25/49/26
GEG NGM 24hr	38/52/10	21/48/31	39/38/23	39/45/16	34/46/20
GEG LFM 36hr	57/31/12	20/47/33	32/44/24	77/21/ 2	47/36/17
GEG NGM 36hr	58/34/ 8	25/48/27	52/28/20	52/37/11	47/37/16
GEG LFM 48hr	42/38/20	9/31/60	28/39/33	62/30/ 8	35/34/31
GEG NGM 48hr	52/31/17	28/35/37	51/30/19	62/27/11	48/31/21

YEARLY TOTALS

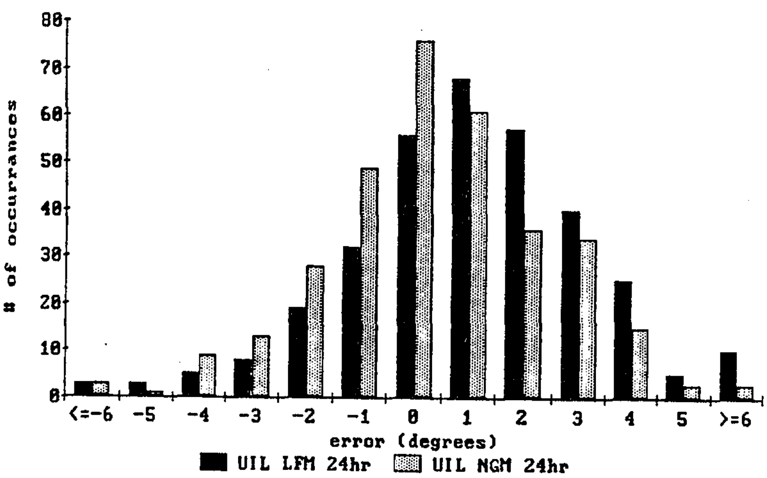
UIL - 12hr Temps. (yearly totals)
FIGURE 1



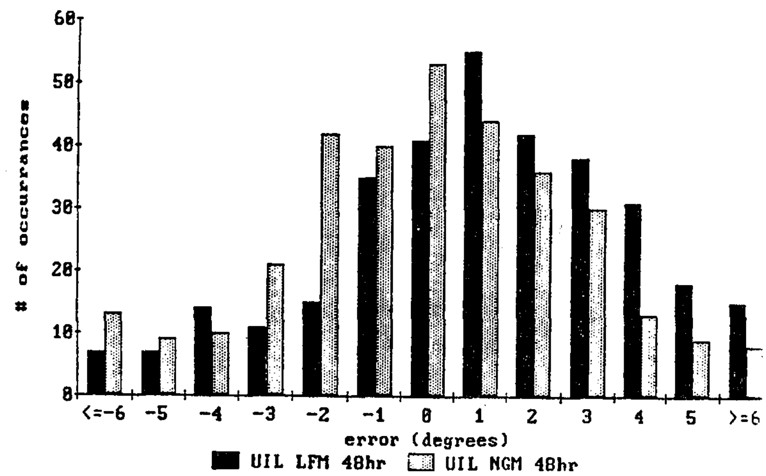
UIL - 36hr Temps. (yearly totals)
FIGURE 2



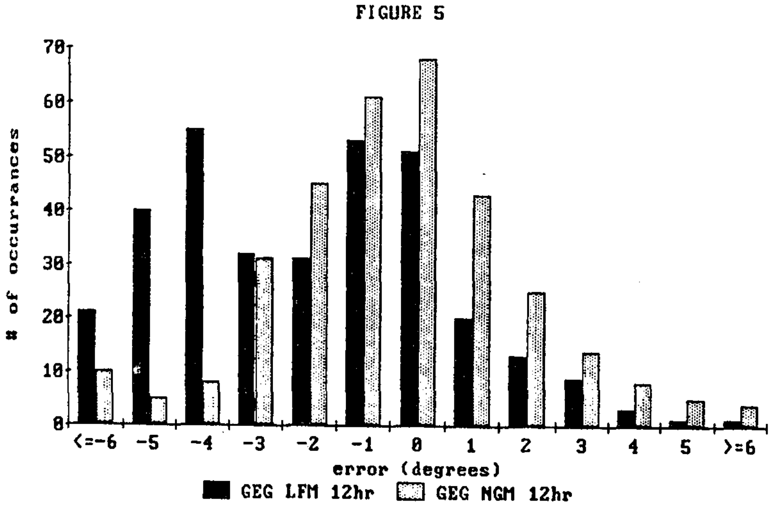
UIL - 24hr Temps. (yearly totals)
FIGURE 3



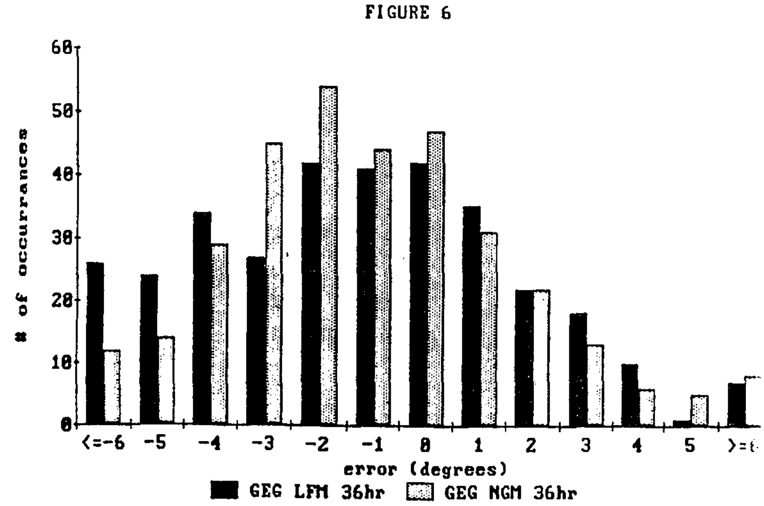
UIL - 48hr Temps. (yearly totals)
FIGURE 4



GEG - 12hr Temps. (yearly totals)
FIGURE 5



GEG - 36hr Temps. (yearly totals)
FIGURE 6



YEARLY TOTALS (CONT.)