An Analysis of Model Day 5 Max Temperature Forecasts for the WFO San Joaquin Valley County Warning Area

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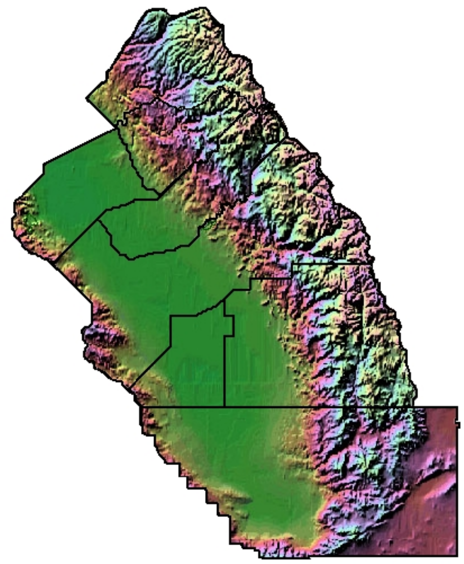
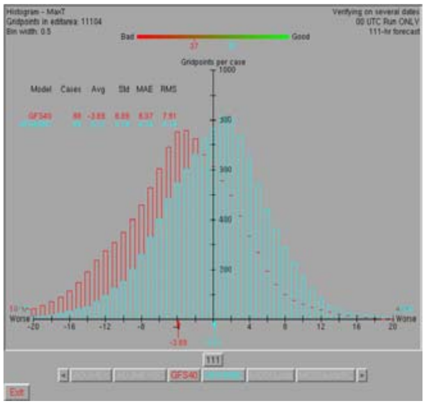
1. Introduction



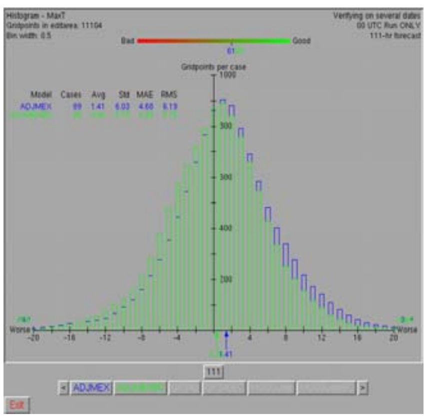
It has been generally accepted that the use of "Bias Corrected" gridded forecast output has been beneficial during the forecast process. This output is viewable through the Graphical Forecast Editor (GFE) and used to display and edit gridded forecasts. This paper will take a look at how the bias corrected (BC) gridded output performed during the winter months of December 2007 through February 2008, over the San Joaquin Valley CA WFO county warning area (CWA) (shown at the right). The analysis will include a verification of forecasts from model output and in particular, maximum temperature (MaxT) forecasts on day five. Model output for this study included the raw GFS run compared with derived gridded output, which includes adjustments to the base GFS run. These adjusted grids utilize statistical guidance which is used to reanalyze the forecast fields for elements such as temperature, dew point and winds. NCEP transmits "Gridded MOS" products to all WFOs displayable in both graphical and gridded form using AWIPS and GFE. These products have come to be called MOSGuide products and use statistical output statistics (MOS) to adjust GFS output in gridded form. The other gridded product used in this study is another GFS based product known as the ADJMEX. This product uses GFS MOS guidance data which are analyzed into the GFE grids through a process called smart-initialization. To compare overall seasonal performance during the winter months, the full 90 day period of concern was analyzed using BOIVerify. This statistical analysis program was used to produce bias and mean absolute error statistics for the parent GFS model run and the MOS adjusted grids. A final comparison of these grids is made against the grids in which the computed bias correction has been applied. Model runs were limited to the 00Z run for this analysis. The bias correction factor was computed over a running 30 day period where each day's bias is recomputed over the last 30 day period.

MaxT Forecast for Day 5



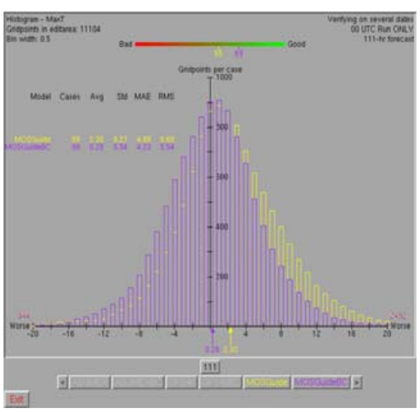
	GFS	BC Grid
Avg	-3.89	0.12
Std	6.89	6.14
Mae	6.07	4.74

Fig 1. GFS vs GFSBC



	Adj mex	BC Grid
Avg	1.41	0.30
Std	6.03	5.75
Mae	4.68	4.40

Fig 2. Adjmex vs AdjmexBC



	MOS Guide	BC Grid
Avg	2.30	0.28
Std	6.27	5.54
Mae	4.88	4.23

Fig 3. MOSGuide vs MOSGuideBC

2. Analysis of Max Temperatures Forecasts for Day 5.

The graphical charts to the left depict the comparison and verification of the parent gridded model output with that of the derived bias corrected one. Again this verification was computed for the three month winter period to obtain a seasonal representation of how the models performed overall. The forecast element was Max Temperature computed from the 00Z run of the GFS along with the derived output using extended statistical guidance from the MEX and MOS products.

Fig 1 displays the distribution of errors for the forecasted maximum temperature grid verifying on day 5. This graph is a comparison of the GFS unadjusted grid with that of the grid where bias correction has been applied. Results show over the winter months, the base GFS run had a significant cold bias averaging of -3.89 F degrees. With the bias correction applied, the bias error was significantly reduced to an average of 0.12 F degrees. Mean absolute error was also reduced from 6.07 degrees to 4.74 degrees.

In Figures 2 and 3, similar results were noted with respect to those of the GFS. The bias corrected Adjmex grid shows an average improvement of over a degree while the improvement was even greater at 2 degrees for the MOSGuide.

In all three cases, the distribution of errors was less for the bias corrected grid over its parent counterpart. Improvement was noted for all three statistical results which included average arithmetic error, standard deviation, and mean absolute error.

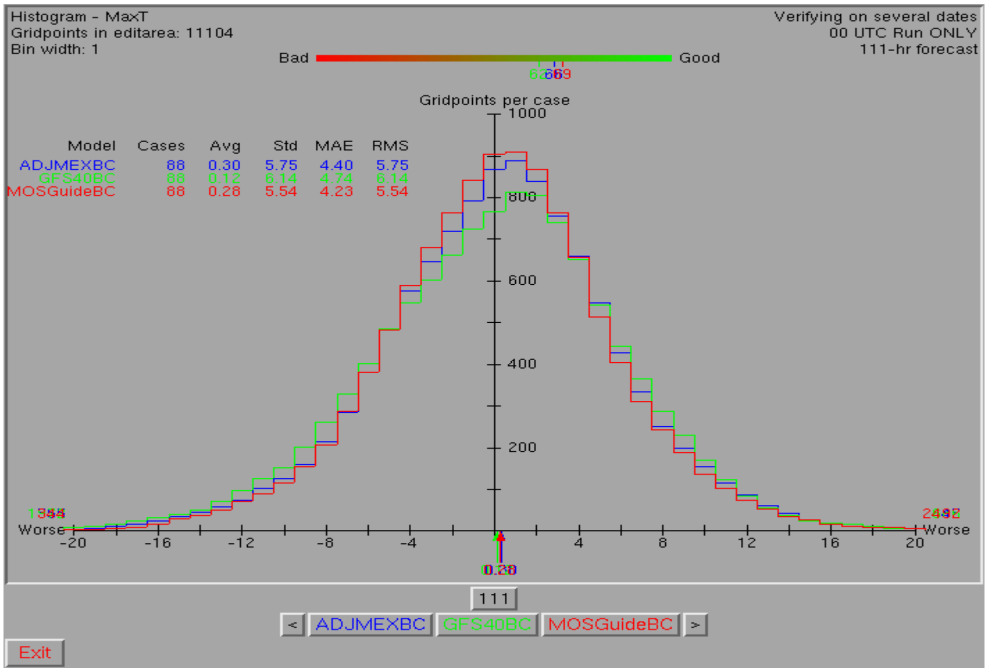


Fig 4. Distribution of Errors for Maximum Temperature Forecast Bias Corrected Grids on Day 5. Comparisons include grids for GFSBC, ADJMEXBC, and MOSGuideBC.

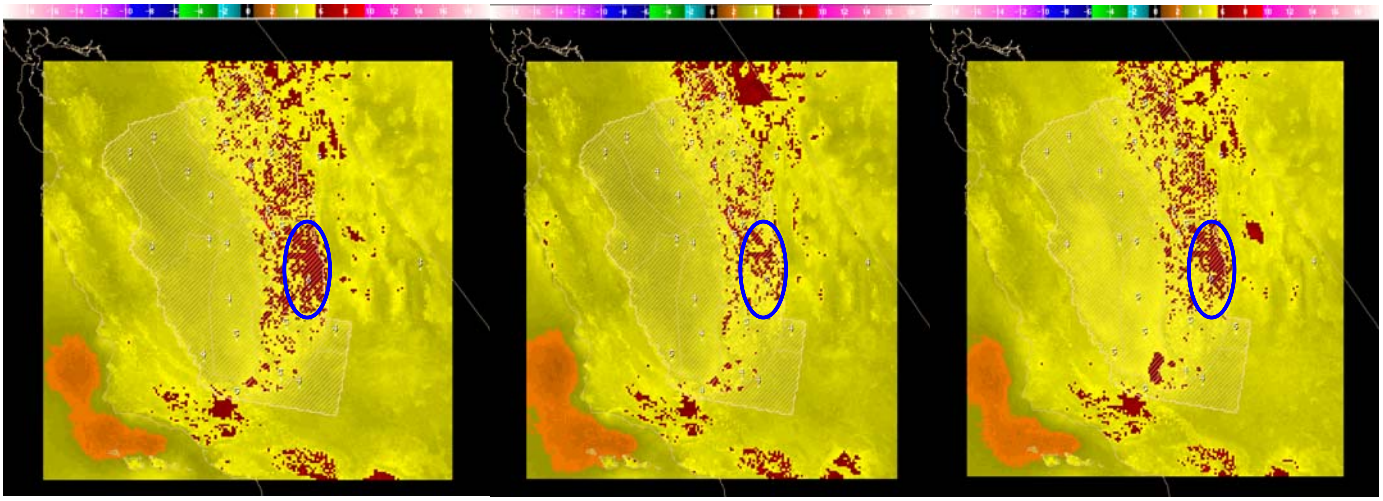
Model	Cases	Avg	Std	MAE	RMS
Adjmex BC	88	0.30	5.75	4.40	5.75
GFS40 BC	88	0.12	6.14	4.74	6.14
MOSGuide BC	88	0.28	5.54	4.23	5.54

The comparison of all three bias corrected model types shows there are only minor difference between them. The most likely reason for this is due to the 3 month period for which these computations were made. The statistical results from using this length of time will dampen out any outliers and mask the stronger cold and warm anomalies which may have occurred during this period. There is also a tendency for the MOS guidance to trend more towards climatology during the extended forecast period which will result in less variability during the day 4 through 7 period. The use of a three month period, though, will help identify the model which has lower consistent errors or biases and is the better overall performer during the winter period.

The results displayed in Fig 4 indicate the best performer for the max temperature forecast on day 5 is the MOSGuideBC forecast grid with the AdjmexBC a close second. The GFSBC model actually had the least average error at 0.12 ° F, but standard deviation and mean absolute error were the worst with about a half degree difference over the MOSGuideBC model. These results also demonstrate the importance of having MOS guidance analyzed into the forecast grids which helps improve the day 5 guidance during the forecast process.

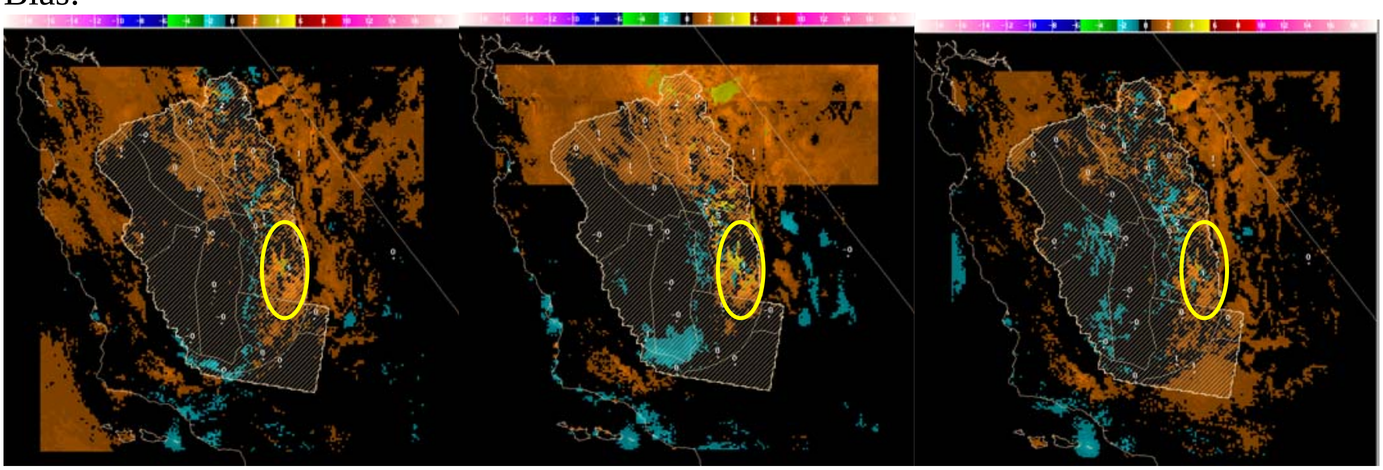
Gridded View Mean Absolute Error and BIAS for
Day 5 Max Temp
Over the 90 Day Period (Dec – Feb)

Mean Absolute Error:



AdjmexBC MOSGuideBC GFSBC

Bias:



The above figures show the mean absolute error and bias grids compiled over a 90 day period for the day 5 forecast over the San Joaquin Valley WFO county warning area. For the San Joaquin Valley and Kern County deserts, biases varied very little and generally between +2 and -2 °F while mean absolute error ranged from 2 to 5 °F. Stronger biases at -3 to +5 °F and greater mean absolute errors of 2 to 7 °F are noted over the mountainous regions of the CWA. Visually viewing the MAE charts, the MOSGuideBC grid has the lesser errors overall, especially over the Southern Sierra Nevada. The concentration of 6 °F + mean absolute errors outlined by the blue oval above are over areas of the Sierra Nevada where there are deep canyons surrounded by peaks and ridges which reach from near 10,000 feet to over 12,000 feet high. A relatively strong warm bias is also noted in this region (Yellow ovals) which can indicate a consistent error produced by the BC adjusted model grids to not forecast cold enough temperatures over the higher terrain.

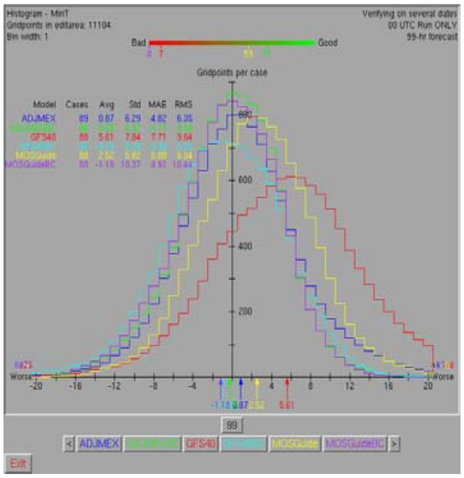


Fig 5. Day 5 MinT Forecast Histogram

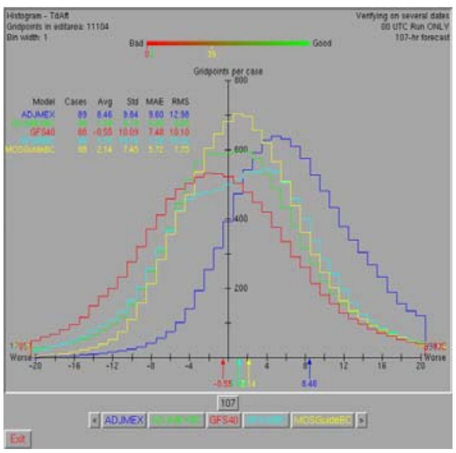


Fig 6. Day 5 TdAft Forecast Histogram

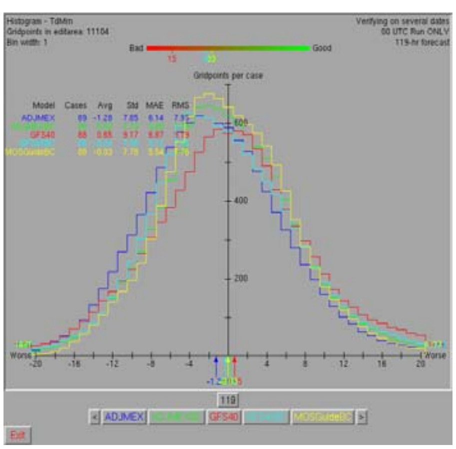


Fig 7. Day 5 TdMrn Forecast Histogram

3. A Quick Look at a Few other Grid Elements

Figures 5, 6 and 7 show the histograms for minimum temperature and two dew point parameter grids called TdMrn and TdAft. Again these stats are computed over the 3 month winter period for the day 5 forecast.

Minimum Temp:

Model	Cases	Avg	Std	MAE	RMS
Adjmex BC	88	-0.25	5.37	4.82	6.35
GFS40 BC	88	-0.93	6.28	4.90	6.35
MOSGuide BC	88	-1.18	M	4.92	M

Results for minimum temperature show the AdjmexBC grid had better verification while the MOSGuideBC was comparable.

Td Afternoon:

Model	Cases	Avg	Std	MAE	RMS
Adjmex BC	88	1.08	9.79	6.85	9.85
GFS40 BC	88	1.15	10.15	7.28	10.10
MOSGuide BC	88	2.14	7.45	5.72	7.75

Td Morning:

Model	Cases	Avg	Std	MAE	RMS
Adjmex BC	88	0.03	7.73	5.88	7.70
GFS40 BC	88	-0.24	7.95	6.12	7.95
MOSGuide BC	88	-0.03	7.76	5.54	7.76

The dew point parameter grids show more variability with mean absolute error well over the 5 degree mark. Comparison, though, shows MOSGuideBC to have the lesser error overall.

4. Conclusion

Statistical results from the BOIVerify tool show the longer 90 day analysis is consistent with shorter term analyses of 14 or 30 days. The use of derived bias corrected grids from three of the extended model forecasts is beneficial during the forecast process. Hopefully, looking at the full 90 day period over the winter months has identified the model with the least consistent errors and is overall the better performer. The MOSGuideBC grid appears to have the least errors of the 3 models used in this study with the exception of the AdjmexBC showing better results for minimum temperature for the day 5 forecast.

Also discovered was the tendency of all bias corrected models to have a relatively strong warm bias in the area over the Sierra Nevada where the terrain changes sharply between deep canyons and higher peaks/ridges over 10,000 feet . This characteristic may also be compounded by using a grid resolution of 2.5 km and an observational network that may not represent this area.