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LFM WINTER PRECIPITATION BIAS AT SALT LAKE CITY AND CEDAR CITY, UTAH

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It is a well known fact that the LFM has an overall wet precipitation bias in the western states that becomes larger with increasing forecast projection. The bias is also more pronounced during the cool season than the warm season. This bias has been documented by Hirano in NWP Activities Reports [1].

The purpose of this paper is to provide a quantitative analysis of the winter-time bias of the LFM precipitation forecasts for the two stations in Utah, Salt Lake City (SLC) and Cedar City (CDC), for which point specific QPF forecasts are available. It also examines the accuracy of the LFM in forecasting measurable precipitation for SLC and CDC. Salt Lake City is located in northwestern Utah, Cedar City in the southwestern part of the state.

Eight winter months of LFM QPF forecasts were examined for SLC and six for CDC: January-March 1983 and November 1983-March 1984 for SLC, and March 1983 and November 1983-March 1984 for CDC. The data from January and February 1983 were discarded for CDC because the CDC rain gauge had a leak in it. Close to 6500 forecasts were examined in the form of FOUS73 messages (FRH category in AFOS).

The QPF bias was examined first. This was accomplished by comparing the amount of precipitation forecast for each 6-hour period against that which actually occurred. Table 1 illustrates these comparisons.

Except for the first 6-hour forecast period, when precipitation was considerably underforecast, a noticeably wet bias existed and increased with time for both SLC and CDC, but especially CDC. The excessively underforecast precipitation amounts in the first 6-hour period are probably due to the removal of the divergent component of the wind during LFM initialization. This results in no upward or downward vertical motion initially. The wet bias in general is probably the result of the LFM's lack of detailed terrain in the West and the fact that most reporting stations such as SLC and CDC are located in the drier valleys. The model terrain gradually increases beginning on the West Coast and continuing to the Colorado Rockies. This implies upslope conditions for the entire West and does not take into account valleys where upslope conditions are modified.

The accuracy or number of correct LFM forecasts was next examined. Correct forecasts were considered to occur for each 6-hour period that the LFM predicted measurable precipitation and it occurred, or it did not predict measurable precipitation and it did not occur. However, since SLC and CDC are generally dry, receiving annually only 15.31 and 10.26 inches respectively, the majority of forecasts examined (66 percent) were correct because no precipitation was forecast and none occurred. For the most part, these forecasts provided little worthwhile guidance. To obtain a clearer measure of the accuracy of the LFM, a set of data was also derived where the only cases considered were those for which either measurable precipitation was forecast by the LFM or it was observed. Tables 2 and 3 indicate the percent of correct LFM 6-hour forecasts for all cases, and for only those cases when precipitation was forecast or occurred.

While the percent of correct forecasts was generally high when considering all cases, this was not true when considering only those cases when precipitation was forecast or observed. Especially poor was the accuracy in the first 6-hour period. Only 20 percent verified at SLC and 28 percent at CDC. Beyond the first six hours, accuracy in all cases generally decreased with time.

In conclusion, it is quite obvious that the LFM QPFs for both SLC and CDC have an excessively dry bias in the first 6-hour forecast period, and then a significantly increasing wet bias for the remainder of the forecast periods. Quantitative knowledge of this QPF bias should provide the forecaster a basis for adjusting LFM guidance to obtain more realistic QPF forecasts. The forecaster should also possess a better feel for how much confidence to place in the ability of the LFM to predict measurable precipitation at SLC and CDC.

Table 1

Forecast Periods (Hours)	Amount of Precipitation Forecast by FOUS73 Divided by Amount of Precipitation that Occurred (Percent)	
	Salt Lake City	Cedar City
0-6	16	15
6-12	114	148
12-18	134	132
18-24	168	173
24-30	168	173
30-36	180	257
36-42	210	221
42-48	210	343
0-48	151	175

Table 2

SLC	All Cases		Only Cases When Pcpn Fcst or Occurred	
Fcst Periods	No of Fcsts Cor Div by No of Fcsts	Percent Correct	Number of Fcsts Correct Divided by No of Fcsts	Percent Correct
0-6	364/454	80	22/108	20
6-12	378/454	83	68/145	47
12-18	357/454	79	65/165	39
18-24	336/454	74	76/195	39
24-30	322/454	71	58/192	30
30-36	306/454	67	73/222	33
36-42	308/454	68	63/214	31
42-48	295/454	65	67/226	30
0-48	2666/3632	73	496/1467	34

Table 3

CDC	All Cases		Only Cases When Pcpn Fcst or Occurred	
Fcst Periods	No of Fcsts Cor Div by No of Fcsts	Percent Correct	Number of Fcsts Correct Divided by No of Fcsts	Percent Correct
0-6	319/355	90	13/46	28
6-12	313/355	88	26/66	39
12-18	299/355	84	30/84	36
18-24	287/355	81	30/96	31
24-30	274/355	77	27/106	26
30-36	269/355	76	27/112	24
36-42	261/355	74	23/115	20
42-48	261/355	74	23/116	20
0-48	2283/2840	80	199/741	27

Reference:

[1] Numerical Weather Prediction Activities Report, 1981, NOAA, National Weather Service, April 1982.