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ADJUSTING REGIONALIZED MOS POPS

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In the past year or so, a wealth of useful information has been published about NMC guidance. Especially noteworthy have been three articles authored by George Maglaras, NWSFO, SFSS, Washington D.C., entitled "How to Use MOS Guidance Effectively, Parts I-III." The particular article used as a basis for this study was Part III, which can be found in Western Region Technical Attachment No. 87-37, September 22, 1987. It discusses how the forecaster can improve on the regional MOS POP equations.

MOS POP guidance is regionalized; the same MOS equation produces the probability forecasts for all stations in a particular region. As shown in Figures 1 and 2, regions for the MOS POP equations are selected based upon similar climatic characteristics and precipitation frequencies. The MOS equation is developed using observations and model output from each MOS site within that region. Therefore, the predictors and coefficients of the MOS equation apply to all sites within a region. For the warm season, Salt Lake City (SLC), Utah; Bryce Canyon (BCE), Utah; and Flagstaff (FLG), Arizona use the same equation (Figure 1), while the cool season equation includes SLC; Cedar City (CDC), Utah; FLG; and Zuni, New Mexico (Figure 2).

Regionalized MOS POP equations tend to overforecast (underforecast) the POP at stations that possess a lower (higher) frequency of precipitation than the mean value that applies to the region. Although precipitation frequency is not used directly in deriving the equations, the fact that observational data from each site is used in their development implies that the equation will reflect the mean precipitation frequency of all sites. Maglaras recommends that forecasters compare the frequency of precipitation of each station in the region against the mean frequency of precipitation of the region and where there are significant differences, adjust the MOS POPS accordingly.

Gary Carter of TDL provided the mean frequencies of precipitation for the regions which include SLC and CDC (Table 1). His data is broken down into the warm and cool seasons and for both model cycles. The warm season comprises April through September and the cool season October through March. The frequencies of precipitation for SLC and CDC were obtained from NOAA Technical Report NWS 39, "Monthly Relative Frequencies of Precipitation for the United States for 6-, 12-, and 24-H Periods," September 1987. These data are in Table 2. They represent the relative frequency of 0.01" of precipitation for the times and months listed.

The differences between the mean frequencies of precipitation for the region and actual monthly frequencies of precipitation for SLC and CDC can be found in Table 3. Positive (negative) numbers indicate the percent difference the mean regional frequency of precipitation is below (above) the actual monthly frequency of precipitation for SLC and CDC. Thus, the station whose actual monthly frequency of precipitation is above (below) the mean regional frequency of precipitation may have a POP which is below (above) what might be expected. For example, during April the frequency of precipitation at SLC at night is 22.3% but the

regional frequency of precipitation is only 12%. Thus, the forecaster knows climatologically the POP is too low. On the other hand, in September, the frequency of precipitation at SLC during the day is 13.8% and the regional frequency is 14%, indicating that climatologically the POP has little or no bias.

How best can the forecaster routinely use Table 3 to adjust the MOS POP guidance? Since there is no direct relationship between the percent difference between the regional frequency of precipitation and the individual station's frequency of precipitation, and between the MOS POP and what percentage it should be adjusted based on these differences, any adjustments must be accomplished subjectively. Without a study on what the climatological bias is in the MOS POPs during each month of the year, the best way to adjust the MOS POP may be to use Table 3 as a "tie-breaker." For example, if the forecaster feels the POP should be around 20 or 30%, and is forecasting for a station during a month when its frequency of precipitation is greater than the regional frequency of precipitation, then if the MOS POP is 20%, the forecaster would probably want to go 10% higher and forecast 30%. This would be especially true if the difference between the regional and individual frequency of precipitation was $\geq$ 5%. Exactly how much to deviate from MOS will come either from experience through the use of Table 3 or from a study which indicates the MOS monthly climatological bias.

There is also a lot of other useful climatological information in Tables 2 and 3. Table 3 implies that MOS POPs for SLC may be too low for the entire year except for the daytime during summer when they may be a little high. For CDC, MOS POPs may be too high for the entire year except for the nighttime during the spring when they may be a little low. This data confirms what I have felt to be the case based on my forecast experience in Utah. The largest overall differences between regional and individual frequencies of precipitation at SLC and CDC occur in March. For example, the frequency of precipitation at SLC during March for both day and night is about 27%, while the corresponding regional frequency of precipitation is only 16%. The exact opposite occurs during June when the MOS POPs are the most overforecast for SLC and CDC. These are but a few examples of what a forecaster can learn by carefully studying these tables.

It is refreshing to note how much useful information has been published recently on NMC guidance. Part III of Maglaras' articles on "How to Use MOS Guidance Effectively" provided the basis of this study and has resulted in a great deal of useful climatological information for the forecasters at the SLC WSFO and a tool to adjust MOS POPs in the right direction.

Acknowledgements:
Comments by Gary Carter, TDL, and Western Region SSD were very much appreciated.

References:
1. Maglaras, George, 1987: "How to Use MOS Guidance Effectively, Part III", Western Region Technical Attachment No. 87-37, September 22, 1987.

2. Maglaras, George, 1987: "How to Use MOS Guidance Effectively, Part I", Western Region Technical Attachment No. 87-41, October 20, 1987.

3. Maglaras, George, 1987: "How to Use MOS Guidance Effectively, Part II", Western Region Technical Attachment No. 87-42, October 27, 1987.

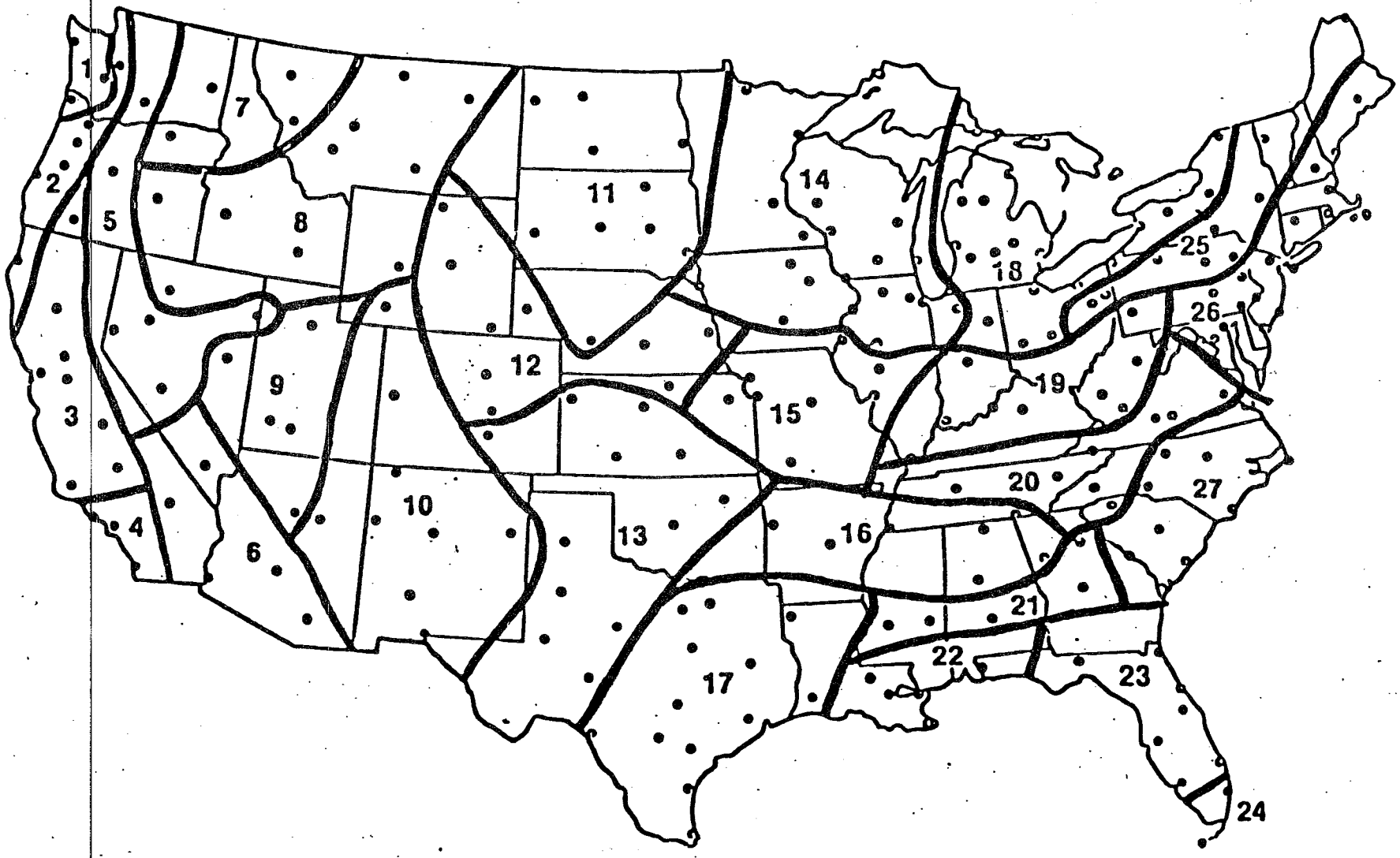

Figure 1. The 27 regions used to derive PoP equations for the warm season.

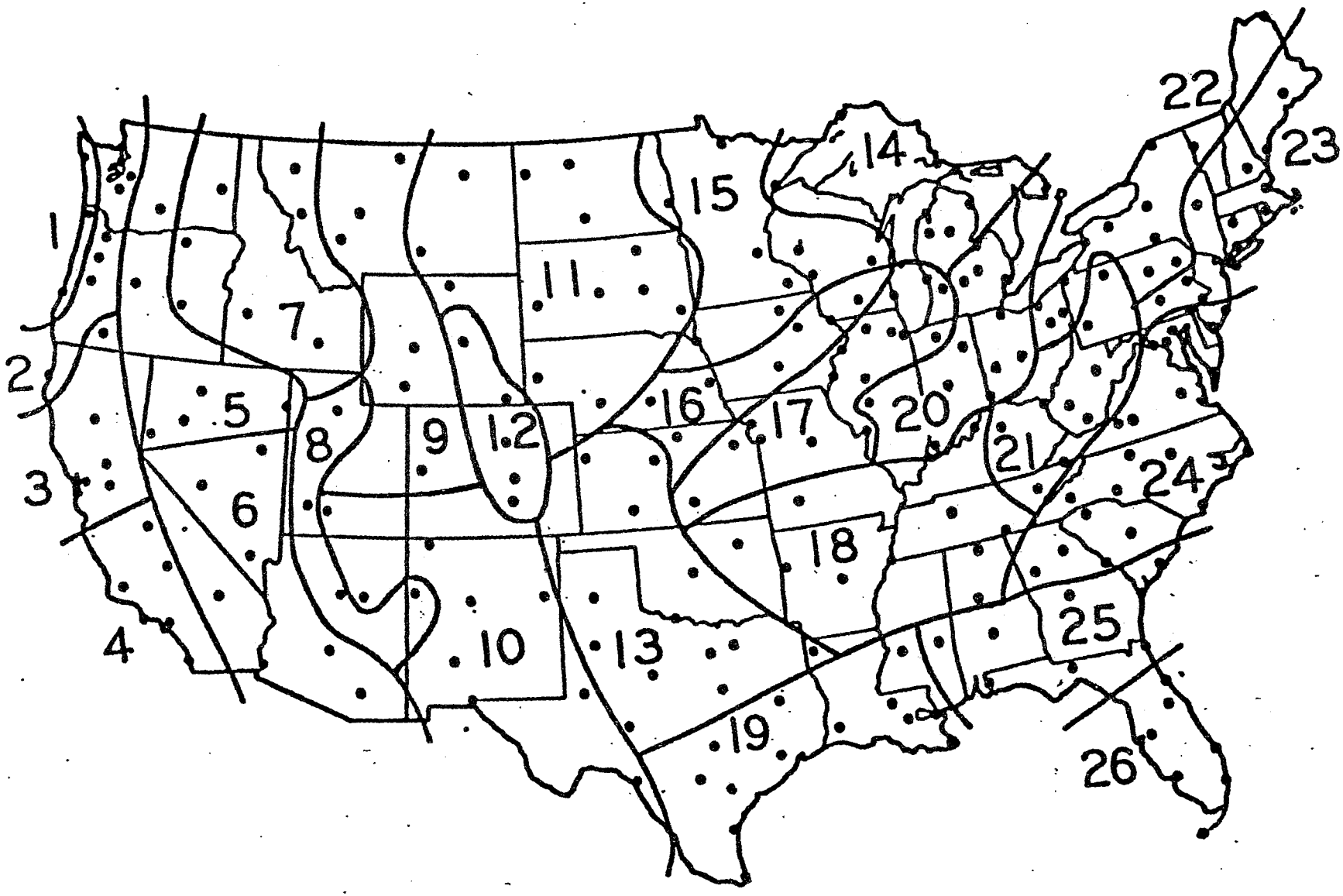

Figure 2. The 26 regions used to derive PoP equations for the cool season.

TABLE 1

Regional Frequencies of Precipitation

	Times	
Season	00-12Z (pct)	12-00Z (pct)
Cool	16	16
Warm	12	14

TABLE 2

Relative Frequencies of 0.01 Inches or More of Precipitation

SALT LAKE CITY, UTAH (SLC)

	00-06	06-12	12-18	18-24 (GMT)	00-12	12-24	00-24
JANUARY	0.134	0.174	0.170	0.134	0.211	0.214	0.317
FEBRUARY	0.142	0.163	0.155	0.128	0.223	0.223	0.327
MARCH	0.194	0.186	0.208	0.186	0.270	0.273	0.392
APRIL	0.174	0.156	0.149	0.138	0.223	0.197	0.313
MAY	0.127	0.171	0.146	0.164	0.208	0.233	0.303
JUNE	0.085	0.056	0.049	0.074	0.105	0.103	0.170
JULY	0.104	0.050	0.025	0.084	0.136	0.100	0.197
AUGUST	0.082	0.052	0.052	0.079	0.114	0.114	0.189
SEPTEMBER	0.113	0.103	0.108	0.074	0.151	0.138	0.221
OCTOBER	0.129	0.114	0.119	0.097	0.171	0.154	0.231
NOVEMBER	0.128	0.126	0.123	0.123	0.187	0.185	0.277
DECEMBER	0.161	0.151	0.174	0.149	0.221	0.231	0.330

CEDAR CITY, UTAH (CDC)

	00-06	06-12	12-18	18-24 (GMT)	00-12	12-24	00-24
JANUARY	0.082	0.100	0.127	0.082	0.142	0.157	0.216
FEBRUARY	0.098	0.091	0.063	0.079	0.135	0.112	0.199
MARCH	0.146	0.149	0.159	0.142	0.209	0.225	0.328
APRIL	0.092	0.090	0.075	0.082	0.136	0.111	0.194
MAY	0.088	0.070	0.067	0.109	0.128	0.134	0.199
JUNE	0.031	0.013	0.010	0.041	0.039	0.049	0.080
JULY	0.084	0.040	0.025	0.117	0.092	0.132	0.192
AUGUST	0.097	0.045	0.035	0.092	0.113	0.104	0.168
SEPTEMBER	0.075	0.049	0.041	0.069	0.090	0.085	0.149
OCTOBER	0.077	0.085	0.074	0.077	0.109	0.112	0.177
NOVEMBER	0.087	0.095	0.085	0.095	0.126	0.124	0.183
DECEMBER	0.067	0.079	0.073	0.062	0.105	0.098	0.159

TABLE 3

Difference Between Actual Monthly Frequency of Precipitation at Salt Lake City and Cedar City and Regional Frequency of Precipitation (Local % - Regional %)

	SLC		CDC	
	00-12Z (PCT)	12-00Z (PCT)	00-12Z (PCT)	12-00Z (PCT)
JAN	+5.1	+5.4	-1.8	-0.3
FEB	+6.3	+6.3	-2.5	-4.8
MAR	+11.0	+11.3	+4.9	+6.5
APR	+10.3	+5.7	+1.6	-2.9
MAY	+8.8	+9.3	+0.8	-0.6
JUN	-1.5	-3.7	-8.1	-9.1
JUL	+1.6	-4.0	-2.8	-0.8
AUG	-0.6	-2.6	-0.7	-3.6
SEP	+3.1	-0.2	-3.0	-5.5
OCT	+1.1	-0.6	-5.1	-4.8
NOV	+2.7	+2.5	-3.4	-3.6
DEC	+6.1	+7.1	-5.5	-6.2