WESTERN REGION TECHNICAL ATTACHMENT
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NGM MOS GUIDANCE UPDATE

[Editor's Note: The following information regarding NGM-based MOS development and early performance results, compared to LFM MOS, were provided by Paul Dallavalle, TDL, at the last Committee on Analysis and Forecast Techniques Implementation (CAFTI) meeting, May 24, 1989.]

NGM-MOS Development

Since May 1987, TDL has issued NGM-based perfect prog guidance (Fig. 1) for 204 stations in the contiguous United States. Forecasts are available for max/min temperature, probability of .01 inches or more of liquid precipitation in a 12-h period (PoP), surface wind speed and direction at specific times, and opaque cloud cover in both probabilistic and categorical format. Fig. 2 shows the stations for which the FWC product (FOUS 14 message) is available.

In October 1987, NMC implemented a hemispheric temperature correction to the Nested Grid Model (NGM). Since that time, the formulation of the model physics has remained constant, although there have been minor changes to the numerical calculations and the global data assimilation system used to provide the first guess for the NGM. If we assume that October 1987 marked the beginning of a stable NGM, then we now have about 20 months of model data. In that sample, only one warm season (April - September) is available. TDL's experience indicates quite strongly that one season is inadequate for a typical MOS development, with a minimum of two seasons being preferable.

To accelerate an NGM-based MOS development, TDL and NMC collaborated during the fall and winter of 1988-89 to rerun the operational NGM on historical data. The model was rerun for the period of October 2, 1986 through October 21, 1987. This gave us the added season of data needed to begin development of MOS forecast equations based on the NGM. As a first step in this process, we intend to replace in the summer of 1989 the current perfect prog guidance with MOS forecasts . These forecasts are to be based on newly derived equations for the warm season. In the development of the cool season (October - March) equations, three seasons of NGM output (1986-87, 1987-88, 1988-89) will be used. Assuming that no more statistically significant changes are forthcoming in the NGM physics, we will continue to augment the NGM-based MOS guidance until equations for the full suite of elements currently available in the LFM-based MOS package (FPC product) are developed. Our current plans are to replace entirely the LFM-based MOS forecasts with NGM-based MOS guidance in 1991.

Fig. 3 gives a brief summary of the MOS development from the NGM. Note that for purposes of testing, two months of data (August 1987 and April 1988) were withheld from the original equation development. These two months provided an independent sample. The equations we propose to implement will be developed from all 12 months of available data.

In preliminary testing for max/min temperature and opaque cloud cover, we've found that the NGM-based MOS forecasts are more accurate than the NGM-based perfect prog guidance and are at least as accurate as the LFM-based MOS forecasts. Figs. 4 and 5 summarize some of the early results.

Based on these tests and others that we will present at the CAFTI meeting, we are asking that CAFTI recommend implementation of the new MOS equations as soon as possible. We expect to complete development of the new temperature, PoP, wind, and cloud equations for the warm season by July 1989. The cool season equations will be tested and implemented by September 1989.

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FOUS14 KWBC 050333
HDNG FOUS14 NGM-STAT GUIDANCE    5/05/89  0000 GMT

 DY/HR  05/06  05/12  05/18  06/00  06/06  06/12  06/18  07/00   07/12
NMCFWCDCA
FOUS14 KWBC 050333
DCA  ESC
 POP/MX-MN                    90/ 65         90/ 60         90/ 71  80/ 56
 WIND     1710   1711   1714   1411   1809   2308   3508   3211
 CLDS  0127/4 0019/4 0019/4 0019/4 0028/4 0037/4 0046/4 0037/4
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Figure 1. Sample perfect prog guidance from the NGM for DCA for May 5, 1989, 0000 UTC cycle. The message is available on AFOS as the FWC product.

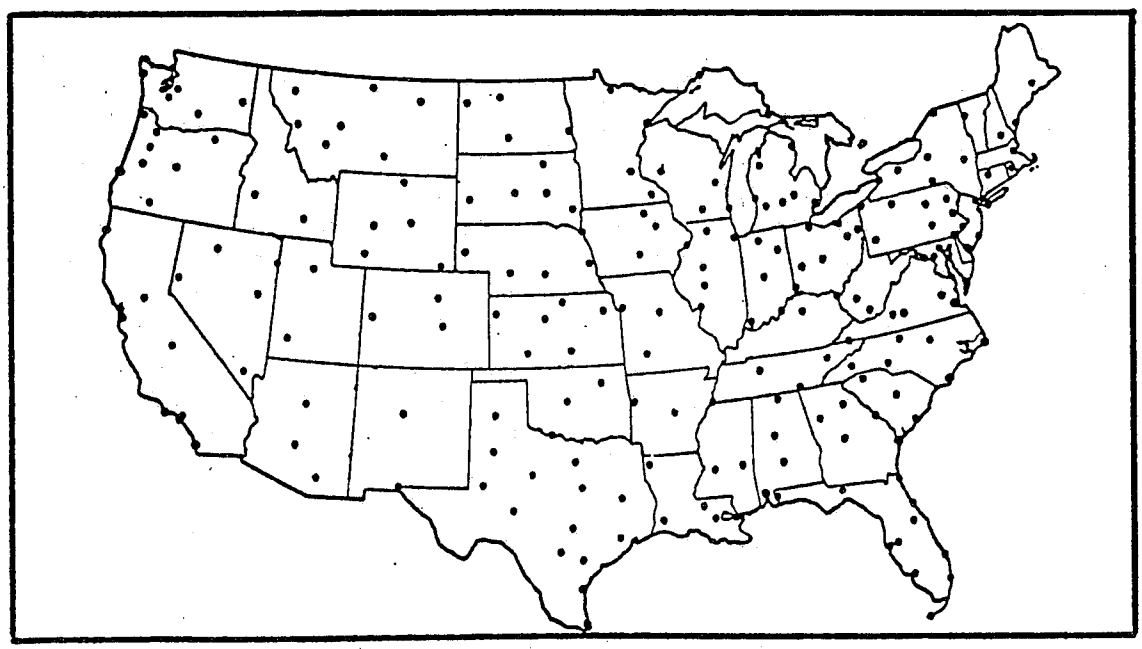

Figure 2.

NEW NGM-BASED MOS GUIDANCE (Warm Season)

. THEORY: The MOS approach requires that an archive of dynamical model forecasts be available for equation development. For most weather elements (including the four listed here), least-squares regression is used to determine relationships between past observations of the particular element (predictand) and numerical model output variables valid at projections near the specific valid time of the predictand. The resulting MOS equations are applied to the same numerical model that supplied the developmental data. MOS equations account for some of the systematic error and bias found in the dynamical model. MOS forecasts also tend toward the climatic mean of the predictand with increasing projection, reflecting the deterioration in dynamical model predictions with increasing projection.

. DEVELOPMENTAL DATA: Two complete warm seasons (April-September, 1987 & 1988) plus eight extra days on each end of both seasons to enhance stability.

. INDEPENDENT DATA: August 1987 & April 1988. Test equations developed from 10 months of data were used to generate NGM-based MOS forecasts. These forecasts were compared with corresponding LFM-based MOS and NGM-based perfect prog forecasts for the test dates.

. PREDICTANDS: Daytime max/nighttime min, 12-h PoP, wind speed and direction, opaque cloud cover (probability of clear, scattered, broken, or overcast).

. PREDICTORS: Thermal, moisture, and dynamical quantities; reflect NGM's resolution in lower troposphere.

. EQUATION APPROACH: Single station for max/min and wind, regionalized for PoP and clouds; regionalized max/min and wind equations were developed for those stations where observations were unavailable.

. POST-PROCESSING: Wind speed forecasts are inflated; best category cloud forecast is made from probability forecasts.

. PROJECTIONS: Both 0000 and 1200 UTC;
Max/Min - 24, 36, 48, 60 h
Wind/Clouds - every 6 h from 6 to 48 h
12-h PoP - 12 to 24, 24 to 36, 36 to 48, and 48 to 60 h

Figure 3. Summary of the NGM-based MOS development.

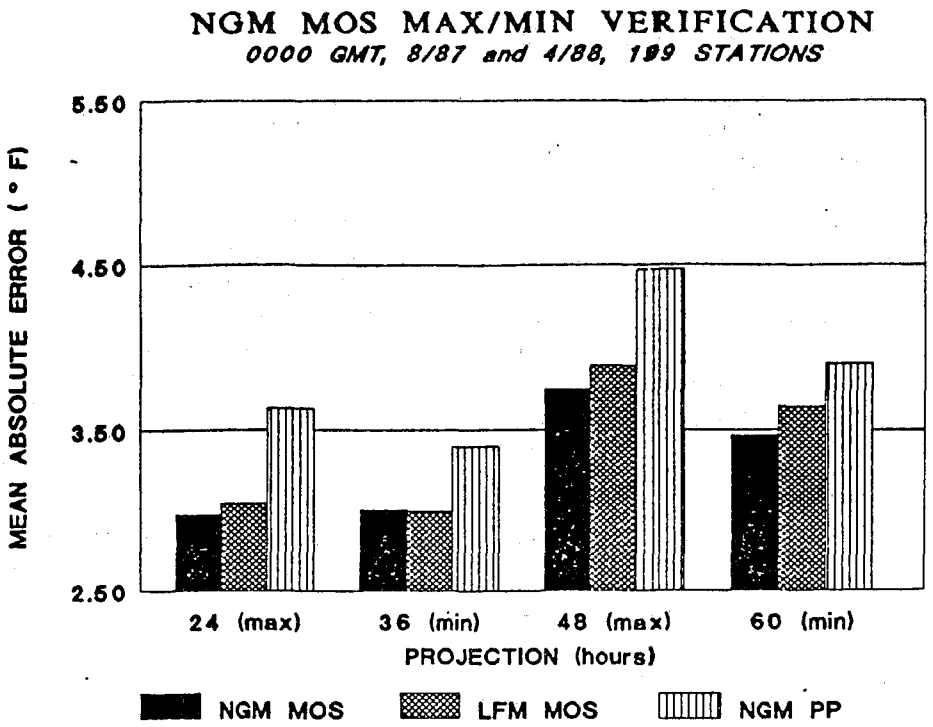

Figure 4. Mean absolute error of NGM-based MOS, LFM-based MOS, and NGM-based perfect prog max/min temperature forecasts for an independent sample of August 1987 and April 1988, 0000 UTC cycle.

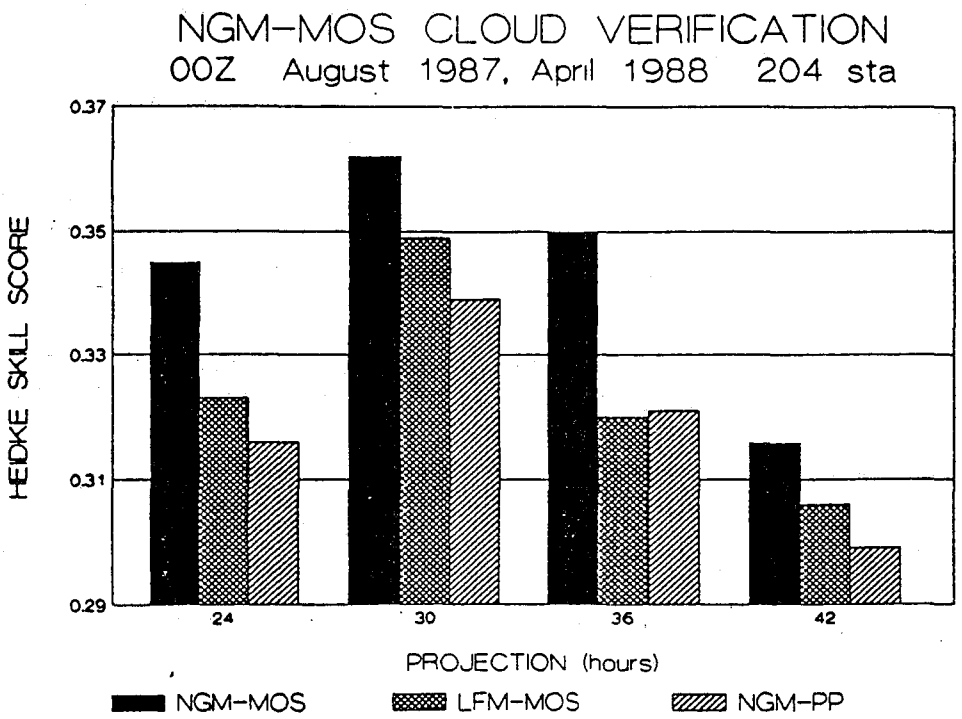

Figure 5. Same as Fig. 4 except for skill scores of cloud forecasts.