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The Computer Worded Forecast: A Field Evaluation

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THE COMPUTER WORDED FORECAST: A FIELD EVALUATION

By

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1. INTRODUCTION

For a number of years, operationally produced computer worded forecasts (CWF's) for WSFO zones and stations have been available on AFOS and the KCRT system (see Glahn, 1978 and 1979; Bermowitz et al., 1980). As of now, CWF's are available for zones of 18 WSFO's on the 0000 GMT cycle and for 111 stations on the 0000 and 1200 GMT cycles.

The purpose of the CWF's is to assist forecasters in the time-consuming task of typing forecasts, thereby allowing them to spend more time on the important tasks of analysis, forecasting, and weather watch. The program was designed to be interactive; that is, the forecaster has the capability of changing all or part of the CWF and its accompanying matrix of forecasts produced by the Model Output Statistics (MOS) technique (Glahn and Lowry, 1972) (see Fig. 1), thereby maintaining complete control over the final product being disseminated to the public. As with any guidance product, quality control of CWF's by the duty meteorologist is very important. There are at least three reasons for this. First, the CWF's are primarily a translation of MOS guidance into phrases. If the MOS forecasts are judged to be poor guidance for a particular cycle, it is very likely that the corresponding CWF's will require change. Second, the CWF's may not adequately describe relatively rare situations (e.g., hurricanes, blizzards) or situations in which geographic features are used in the forecast. Finally, the computer and/or its associated software can go awry.

Currently, there are two versions of the CWF program. The first, or central program, is run twice per day on the NOAA IBM 360/195 (Heffernan and Glahn, 1979); forecasts from it are distributed over AFOS. The second version of the program, referred to as the local program and available for the 0000 GMT cycle only, can be run on station on the AFOS minicomputer. The forecaster, by running this program, can create a new worded forecast. First, however, the digital forecasts in the matrix of MOS forecasts should be changed to values the forecaster believes are more representative of the weather situation. These changes are placed in the appropriate places between lines on the matrix as shown in Fig. 2. Also in Fig. 2 is the new worded forecast which reflects the changes made in the matrix. Of course, another option available to change the CWF is to edit the text directly.

Although a local program exists for both stations and zones, practically speaking, it is most useful for stations. (Actually, software for zones is not physically available on station.) The reason for this is that a matrix is not transmitted for each zone of a group of zones that happen to combine; only a matrix representing the combination is sent. Therefore, if the forecaster thinks the zones should combine differently, appropriate matrices would have to be constructed from the centrally produced matrix to create new CWF's; this can get rather time-consuming. Under these circumstances, the text editing capability would be best to use.

2. FIELD EVALUATION

There are at least two reasons for having a field evaluation of the CWF's. Primarily, it's important to know how useful the CWF's are in assisting the meteorologist prepare his/her forecasts and to determine where improvements in the product can be made. Requirements of users of NWS forecasts have recently been changing, and it may not be possible to satisfy all these requirements with the same forecast format. However, forecasters don't have time to write the same forecasts in several different formats. This is precisely where the CWF's can help, provided they are of good quality. Second, an evaluation introduces the concept of CWF's to offices that may be unaware of its availability.

The field evaluation was coordinated through the Office of Meteorology; the format of the test was determined from input received from the MSD/SSD's of each Regional Headquarters. An important consideration in designing the test was that it not significantly add to the existing workload of the WSFO. Therefore, it was decided that once per day for a period of one month, CWF's for zones of each participating WSFO would be evaluated and comments written directly on copies of the CWF's. At the conclusion of the test period, all forecasts with comments would be returned to TDL via the Regional Offices. Eight WSFO's, two per region, were asked to participate in the field test: Philadelphia, Columbia, S.C., Oklahoma City, San Antonio, Des Moines, Minneapolis-St. Paul, Salt Lake City, and Los Angeles. In addition, it was decided to include unsolicited comments from WSFO Cleveland as part of the test. Cleveland had recently requested that zone CWF's be provided to determine their usefulness for that WSFO's operations. Some of the Regional Offices also volunteered to summarize comments and/or do a similar evaluation.

For the test, we welcomed any comments the forecasters cared to make about the CWF's. However, we were primarily concerned with such things as zone combinations and forecast wording and length. In addition, we wanted to know if a CWF could be used with or without editing and, if it could not be used at all, we wanted to know why. Unfortunately, the value of the test was somewhat diluted because the format of the body of the CWF did not completely match that being used in operations. Just prior to the test, a new format (the so-called "cable TV" format) was introduced for zone forecasts on an experimental basis. Also, the header was standardized. About the time this new zone format was introduced, we had just completed writing software to get the format of the header and forecast to match, as closely as possible, the locally prepared product. Because of the change in format we again revised the software, but only to correct the header. The body of the CWF was left alone because of uncertainties in its future format and the relatively large amount of coding required to make this revision. This problem was mentioned in the evaluation instructions that went to the WSFO's and we asked that the evaluation be performed under the assumption that the format was the one currently in use.

3. RESULTS AND CONCLUSIONS

Responses received from the field indicate that, generally, the zone CWF's are a useful product in locations east of the Rocky Mountains. The following comments, extracted from the responses (see Bermowitz and Miller, 1983 for a compilation of all evaluations), support this conclusion.

From WSFO Des Moines:

"In general, I feel that the computer worded forecasts (CWF's) have merit and are useful. They provide an excellent first guess for the local forecaster and would also serve as a 'check'; i.e., it might highlight or provide an insight to elements not fully considered on the local level."

From WSFO San Antonio:

"We would encourage TDL to proceed with the afternoon version (of the CWF) and fix it up so it will give us the Coleman (period-by-period) format. If there were no objections, many of us would then try to use it in real time."

From WSFO Cleveland:

"Overall, the CWF's make an excellent starting point. We look forward to receiving CWF's for 12Z and adapting (them for) use by the field forecasters."

From Western Region Headquarters:

"To sum, both offices mentioned that the computer-worded forecasts were only useful in a few cases--2 out of 31 days at Los Angeles. The few cases useful in Utah occurred when there was relatively little weather. We hope this information will be useful in further refining this product. It obviously has a ways to go in the Western United States."

The result of the Western Region evaluation is not too surprising since it is often difficult to get representative MOS forecasts at centers of zones--from which the CWF's for zones are made--in areas of highly variable terrain. If there isn't a MOS station in a zone, the CWF program interpolates between existing MOS stations or, less frequently, places values at a nearby MOS station at the zone center. In the West, MOS stations frequently are located in valleys, thereby creating non-representative MOS forecasts in mountainous zones when an interpolation or placement is done. Zone temperature forecasts were a good example of this during the evaluation. Western Region Headquarters states, "Both offices stressed that the temperatures in the mountain zones were too high, apparently using valley temperatures as input."

Although the CWF's were found useful in the three easternmost regions, it is apparent from the evaluation that they need improvement there as well as in the Western Region. For example, from WSFO Oklahoma City,

"...most of the forecasters would agree that by making use of the computer to prepare the forecast, we can improve our efficiency and productivity. At the same time, I think there is general agreement that there is a need to improve the current computer-worded forecasts."

Problems that surfaced as a result of this test were concerned with zone groupings (i.e., combining two or more zones with the same forecast), wording, and format.

As regards zone groupings, the consensus was that the CWF program produces fewer zones per combination (therefore, more total forecasts) than the product prepared on station. Another problem noted by forecasters was inappropriate zone combinations (e.g. coastal and inland zones combining too often). We think there are several reasons for these problems. The first,

which relates solely to the problem of fewer zones per combination than generally desired, has to do with the station specific constants used to define the number of differences in weather elements between zones that could combine. Exceeding this preset number precludes combining. It may be that the values of these constants are too restrictive (i.e., they do not permit enough zones to combine) and will have to be increased. This is easily done, and the values can be different for different WSFO's. Second, and possibly more important than the first, has to do with the stations that are used to specify, either through direct placement or interpolation, MOS forecasts at centers of zones. These forecasts at zone centers are used to generate the zone CWF's. It appears that in many cases the best station selection was not made. This was discovered during working sessions with forecasters on a post evaluation visit to WSFO's Fort Worth, San Antonio, and Oklahoma City. It follows that when the weather situation is such that zones can combine, they may not be combined because of erroneous forecasts at their centers. It also follows that inappropriate combinations may result. A third reason has to do with each WSFO's preferred combinations of zones used in the program. Some of the original information we received about this through correspondence appears to have been incomplete. We have subsequently found out that it is best to get this information through direct discussions with station personnel. It can be done by phone, but it is better to do it via a working session.

Problems involved with wording were mixed. The Minneapolis-St. Paul WSFO reported that "Overall wording of the CWF's was at an acceptable level." However, Western Region Headquarters noted that "Wordiness was another problem mentioned by the reviewers." The most frequent objection concerned specific phrases. Such terms or phrases as "overcast," "little change in temperature," "comfortable temperatures," and "mostly sunny with a slight chance of thunderstorms" were criticized by several reviewers. The use of "breezy" was also questioned, but not as frequently. Some felt that "heavy at times" (in reference to precipitation) was used too often especially in the second and third periods. A lack of punctuation causing rambling sentences was also cited by a few reviewers. Commas are omitted because teletypewriters cannot accommodate them. They are available on our computer printouts of the CWF's and could be inserted on the version of the CWF that is transmitted to the field. However, this will not solve the basic problem of commas not being available on teletype. Mentioning probability of precipitation (PoP) with a value of 10 percent and use of "slight chance" with a 10 percent PoP were additional objections.

Even though we requested the evaluation be done under the assumption that the format of the zone CWF's was the one being used operationally, WSFO's San Antonio and Minneapolis-St. Paul cited that as a hindrance in making full use of its capability. We agree; in fact, we wanted to reformat the CWF for the evaluation but for reasons given earlier in this report, we decided not to.

4. FUTURE WORK

We believe the evaluation has served its two main purposes: publicizing the existence of the CWF program and providing us with the needed information to improve the product's operational capabilities. Over the next several months we will be making changes to the program along the lines suggested by the reviewers.

Probably the most important change is to get the format of the CWF zone forecasts to match exactly the one being used operationally. There is no way

the duty meteorologist can make total use of the CWF's operational capabilities until this is accomplished. Now that the Office of Meteorology, with Regional Office input, has decided such issues as the appearance of headers with cable TV turn-on codes, period-by-period format of the forecasts, combining of periods with similar forecasts (except for the first period which will always stand alone), appearance of headlines, naming of zones, appearance and location of the PoP statement, and others, we can begin work.

Other relatively important changes to make are to determine, with individual WSFO assistance, the proper stations to use for interpolation of meteorological variables to the centers of zones, improved preferred combinations of zones, and whether or not the station specific constants that control whether zones can combine should be made less restrictive. These changes should help alleviate problems of too few and potentially inappropriate zone combinations. Problems caused by interpolation or placement in mountainous zones, principally in the Western Region, are more difficult to solve. Digital MOS forecasts at additional stations would help, but only partially since it is impossible to have a station in each zone.

Finally, we intend to incorporate suggestions received from reviewers regarding terms and phrases. After all changes are made, it may even be appropriate to have another evaluation; certainly it would be performed under more realistic conditions. At that time, we can also evaluate the interactive capability that is available with use of the Eclipse CWF program.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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WBCMCPODG
WOUSØØ KBAL Ø91540
FORECAST FOR          DCA                    VALID TIME
                      12Z   18Z   00Z   06Z   12Z   18Z   00Z   06Z   12Z
ELEMENT     UNITS     (---TODAY---)(-TONIGHT--)(-TOMORROW-)(-TMW NIGHT--)
TEMP MAX    DEG F           45            22            39            18
TEMP        DEG F     46 43 41 40 40 38 33 29 25 23 28 33 36 30 25
DEW PT      DEG F     43 39 37 36 34 32 27 23 19 17 18 19 20 20 18
POP(12)     PERCENT               48            16            0             0
POP(6)      PERCENT         29    27    14    7     0     0
POF(P)      PERCENT   12    26    58    95    100   100   100   100   100
POZR(P)     PERCENT   0     0     1     0     0     0     0     0     0
PRECP TYP   CATEGORY  3     3     2     2     2     2     2     2     2
QPF         CATEGORY                1             1             1
                                                                        [ ]
                                                                PAGE 01

GUIDANCE MATRIX CON'T
                      VALID TIME
ELEMENT     UNITS     12Z   18Z   00Z   06Z   12Z   18Z   00Z   06Z   12Z
                      (---TODAY---)(--TONIGHT-)(-TOMORROW-)(-TMW NIGHT--)
SNOW AMT    CATEGORY              0
RW/L/R      PERCENT   43/ 5/ 52     32/ 0/ 68     44/ 0/ 56     41/ 0/59
TSTM        PERCENT         0             0             0
SVR TSTM    PERCENT
CLOUDS      CATEGORY  4     4     4     1     1     1     1     1     1
OB VIS      CATEGORY  4     4     1     1     1     1     1
WINDS       DEG MPH   3614  3528  3417  3214  3209  3186  3085  3003  3181
CIG         CATEGORY  3     4     6     6     6     6     6
VIS         CATEGORY  3     5     6     6     6     6     6
                                                                        [ ]
YESTERDAY'S MAX  45                   FORECASTER'S NUMBER       PAGE 02

WBCOLTDCA
WOUS90 KBAL 301600
DCA FORECAST FOR WASHINGTON, DC
MONDAY 11 FEB 1980

OVERCAST WITH A CHANCE OF RAIN THIS MORNING BECOMING MIXED WITH SNOW
IN THE AFTERNOON. CHILLY HIGH IN THE LOWER 40S. NORTHERLY WINDS 15
TO 20 MPH. TONIGHT--CLOUDY CLEARING BY MIDNIGHT. LOW IN THE LOWER 20S.
NORTHWESTERLY WINDS 10 TO 20 MPH. TUESDAY--CLEAR AND COLD HIGH IN THE
UPPER 30S. PROBABILITY OF PRECIPITATION 50 PERCENT TODAY 20 PERCENT
TONIGHT AND NEAR 0 PERCENT TUESDAY.                              PAGE 01
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Figure 1. Sample forecast matrix of MOS forecasts and computer worded forecast for Washington, D.C. as it appears on AFOS.

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WBCMCPODG
WOUSØØ KBAL Ø91540
FORECAST FOR          DCA                    VALID TIME
                          12Z   18Z   00Z   06Z   12Z   18Z   00Z   06Z   12Z
ELEMENT       UNITS    (---TODAY---)(-TONIGHT--)(-TOMORROW-)(-TMW NIGHT--)
TEMP MXM      DEG F          46           22           38           18

TEMP          DEG F    46 43 41 40 40 38 33 29 25 23 28 33 36 30 25
                          39 36 34 32 29 26
DEW PT        DEG F    43 39 37 36 34 32 27 23 19 17 18 19 20 20 18

POP(12)       PERCENT                48           16           0          0
                                     60           30
POP(6)        PERCENT        29      27    14     7     0      0
                             45      30    25
POF(P)        PERCENT   12   26      58    95     100   100    100   100   100
                           70      100   100
POZR(P)       PERCENT    0    0      1     0      0     0      0     0     0

PRECP TYP     CATEGORY   3    3      2     2      2     2      2     2     2
                           2
OFF           CATEGORY                1           1           1                [ ]
                                                                        PAGE  01

GUIDANCE MATRIX CON'T
                                     VALID TIME
ELEMENT       UNITS    12Z   18Z   00Z   06Z   12Z   18Z   00Z   06Z   12Z
                      (---TODAY---)(--TONIGHT-)(-TOMORROW-)(-TMW NIGHT--)
SNOW AMT      CATEGORY                0

RW/L/R        PERCENT  43/ 5/ 52     32/ 0/ 68     44/ 0/ 56     41/ 0/59

TSTM          PERCENT        0             0             0             0

SVR TSTM      PERCENT

CLOUDS        CATEGORY   4    4      4     1      1     1      1     1     1

OB VIS        CATEGORY   4    4      1     1      1     1      1

WINDS         DEG MPH  3614 3520   3417  3214   3209  3106   3005  3003  3101

CIG           CATEGORY   3    4      6     6      6     6      6

VIS           CATEGORY   3    5      6     6      6     6      6

YESTERDAY'S MAX  45                          FORECASTER'S NUMBER          [ ]
                                                                        PAGE  02

UBCRWFDCA
WOUS00 KBAL 251100
DCA FORECAST FOR WASHINGTON, DC
MONDAY 11 FEB 1980

RAIN LIKELY THIS MORNING CHANGING TO SNOW ABOUT MIDDAY. EARLY MORNING
HIGH IN THE LOWER 40S BECOMING COLDER DURING THE DAY. NORTHERLY WINDS
15 TO 20 MPH. TONIGHT--CLOUDY WITH A CHANCE OF SNOW IN THE EARLY
EVENING CLEARING BY MORNING. LOW IN THE LOWER 20S. NORTHWESTERLY
WINDS 10 TO 20 MPH. TUESDAY--CLEAR AND COLD HIGH IN THE UPPER 30S.
PROBABILITY OF PRECIPITATION 60 PERCENT TODAY 30 PERCENT TONIGHT AND
NEAR 0 PERCENT TUESDAY.

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Figure 2. Sample forecast matrix shown in Fig. 1 with changes to some forecasts placed under the original values. Worded forecast is based on the matrix that incorporates these changes.