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computer

A DECODER FOR RAOBS AND ITS APPLICATION

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1. SUMMARY

This program decodes the significant level portion of a raob (second transmission, TTBB) as it is received on AFOS, and places the decoded information into two files; one containing temperature and dewpoint information and the other containing vertical wind profile information. Much of the program involves string searches for various code groups of the raob. The program output, the raob in simple decoded form, can then be used by various user programs to perform analysis routines useful to the forecaster.

2. BACKGROUND INFORMATION

The AFOS software package is designed to handle all the communication tasks, data storage, and processing of user commands from an AFOS console. This software package was built around the main operating system software, Real-time Disk Operating System (RDOS), that is normally used with the Data General Eclipse S230 (AFOS) computer. The computer itself is divided into two partitions; Foreground and Background. AFOS operates in Foreground, leaving Background available for local user programs. Although user programs are executed in Background, they often require data that is stored by AFOS running in Foreground. Since little information was available to the author concerning AFOS file structure, all files used or created by the program are RDOS files. The input file (the raob) can be easily made into an RDOS file by simply SAVING the

```
VERDAY
TYPE SGLDECODER.FR
C       DECODES THE TTBB RAOB TRANSMITION INTO
C       TWO RDOS FILES;
C       ONE FOR TEMPERATURES AND DEWPOINTS,
C       AND ONE FOR WINDS. IF THE FORMAT IN THE
C       FILE IS NOT CORRECT, IT WILL TYPE OUT A
C       FLAG MESSAGE TO THAT EFFECT ON THE
C       DASHER AND EXIT THAT PORTION OF THE
C       PROGRAM.
C
C       SPLITS THE "WORDS" OF THE AFOS FILE NOW
C       STORED IN "RAOB.BB" INTO THE TWO BYTE
C       COMPONENTS AND PUTS EACH BYTE ASCII
C       CHARACTER INTO SEPARATE WORDS OF A
C       NEW ARRAY NAMED "IARRAY".
        DIMENSION  IARRAY(0:511),IDATA(1024),IPRESS
        (50),TEMP(50),DEPR(50),
     1  ILVL(50),IDIR(50),ISPEED(50)
        CALL OPEN(6,"RAOB.BB",2,TER)
        CALL WRBLK(6.0,IARRAY,2,IER)
        IMASK1=177400K
        IMASK2=377K
        DO 25 I=0,511
        N=(I+1)*2
        NM1=(1*2)+1
        IDATA(N)=AIAND(IMASK2,IARRAY(I))
        IDATA(NM1)=IAND(IMASK1,IARRAY(I))
        IDATA(NM1)=ISHFT(IDATA(NM1),-8)
    25  CONTINUE
C       N IS A CHARACTER POINTER USED TO GUIDE
C       US THRU THE ARRAY "IDATA"
        N=1
C       STRING SEARCH FOR "B""B""SPACE""SPACE"
        DO 50 I=1,70
        IF(IDATA(I) .NE. 1028) GO TO 49
        IP1=I+1
        IF(IDATA(IP1) .NE. 102K) GO TO 49
        IP2=I+2
        IF(IDATA(IP2) .NE. 040K) GO TO 49
        IP3=I+3
        IF(IDATA(IP3) .NE. (040K) GO TO 49
        N=1+4
        GO TO 51
    49  N=N+1
    50  CONTINUE
        WRITE(10,3) N
     3  FORMAT(5X,I3,1X,"DATA DOES NOT CONFORM
        TO FORMAT SPECIFICATIONS")
```

file from AFOS into a file named "RAOB.BB" (i.e. SAVE: SLCSGLSLC DP@:RAOB.BB). However, since this program was written, software has been developed to access the AFOS database directly from a FORTRAN program.

3. PROGRAM DESCRIPTION

The program begins by restructuring the file "RAOB.BB". Since each Data General Computer Word (two bytes) holds two ASCII characters (two single digit numbers or two letters), one has to look at each half of the word to examine individual characters. This can get awkward if one doesn't know which half of the word (which byte) contains the desired character. To get around this difficulty, the program splits the 512 words (2 blocks) of the array "IARRAY", which is nothing more than the core image of the file "RAOB.BB", into 1024 words in an array called "IDATA". Each word or element of "IDATA" contains a null (000) in the left byte and the ASCII character in the right byte. Once this is done, the decoding process can begin.

The program performs character or string searches through the array "IDATA" to find beginning points for decoding. The variable "N" is the pointer used in the program to indicate which element of "IDATA" is being examined. The format for the raob code can be found in Federal Meteorological Handbook No. 3, Radiosonde Observations".

The first search is for a four character string of "B" "B" "Space" "Space"; the beginning of the coded information (gets the pointer past any AFOS headings). It then searches for the next 5-digit group, which is the date/time group, and assigns these to "IDATE" and "ITIME". The following group is decoded as the station number, "ISTATN". The next search is for the "00" group (surface data). The decoded temperature and dewpoint depression are then assigned. The program enters an implied loop, which first

```
      GO TO 215
C     ASSIGNS THE DATE, TIME, AND STATION
C     NUMBER.
   51 NP1=N+1
      NP2=N+2
      NP3=N+3
      IDATE=(10+(!DATA(N)-48))+(IDATA(NP1)-48)-50
      ITIME=(10*(IDATA(NP2)-48))+(IDATA(NP3)-48)
      N=N+S
      NP1=N+1
      NP2=N+2
      ISTATN=(100+(IDATA(N)-48))+(10*(IDATA(NP1)-48)
     )+(IDATA(NP2)-48)
      N=N+4
      M=1
      IPOINT=0
      NP20=N+20
C     STRING SEARCH FOR "00" GROUP.
      DO 70 I=N,NP20
      IP1=I+1
      IF((IDATA(I)-48) .EQ. IPOINT .AND. (IDATA(IP1)
     -48) .EQ. IPOINT)
    1 GO TO 80
      N=N+1
   70 CONTINUE
      WRITE(10,3) N
      GO TO 215
C     ASSIGNS THE PRESSURE AT THIS LEVEL.
   80 N=N+2
      NP1=N+1
      NP2=N+2
      IF(IDATA(N) .EQ. (057K) M=M-1
      IF(IDATA(N) .EQ. 057K) GO TO 73
      IPRESS(M)=(100*(IDATA(N)-48))+(10*(IDATA(NP1)-
     48))+(IDATA(NP2)-48)
C     STRING SEARCH FOR THE FIRST INTEGER:
C     0 THRU 9.
   73 N=N+3
      NP10=N+10
      DO 75 I=N,NP10
      DO 76 IJ=0,9
      IF(IDATA(I) .EQ. 057K) N-N+3
      IF(IDATA(I) .EQ. 057K) GO TO 91
      IF((IDATA(I)-48) .EQ. IJ) GO TO 85
   76 CONTINUE
      WRITE(10,3) N
      GO TO 215
C     ASSIGNS THE TEMPERATURE AND DEW POINT
C     DEPRESSION AT THIS LEVEL.
   85 NP1-N+1
      NP2=N+2
      ITEMP=((IDATA(N)-48)*100)+(IDATA(NP1)-48)*10)+
      IDATA(NP2)-48)
      ITSIGN=(ITEMP/2)*2
      IF(ITEMP .NE. IISIGN) ITEMP=-ITEMP
      TEMP(M)=(FLOAT(ITEMP)/10.0)
      N=N+3
      NP1=N+1
      IF(IDATA(N) .EQ. 057K) DEPR(M)=-1.0
      IF(IDATA(N) .EQ. 057K) GO TO 91
      IDEPR=(10*(IDATA(N)-48))+(IDATA(NP1)-48)
      DEPR(M)=FLOAT(IDEPR)
      IF(DEPR(M) .LE. 50) DEPR(M)=(DEPR(M)/10.0)
```

searches for a "11" group. When found, the pressure, temperature and dewpoint depression are assigned. A search for a "22" group or end of message character ("=" or 51515 group) is then performed. If a "22" group is found, it recycles through the loop to make assignments at the next level. This continues for the "33", "44", etc., groups until the TTBB message is decoded.

The wind portion, PPBB, decode proceeds in a similar fashion. Searches are made for "9" groups, and assignments of height levels and winds are made. Again an implied loop exists so that when the next "9" group is encountered, the cycle is repeated.

If at any time during the decode phase of the program a code group is not found within the next few elements of "IDATA" (the exact number varies, but usually is 10 elements) or an obvious encoding error is discovered, the program will type out the message "THE DATA DOES NOT CONFORM TO FORMAT SPECIFICATIONS" on the AFOS dasher, along with the "N" number (element number of "IDATA") where the search was terminated. If this occurs in the temperature/dewpoint portion of the program, it will jump to the wind portion and continue. If it occurs in the wind portion, the program will jump to the output portion. The temperature/dewpoint depression information is put into a file named "SOUNDING.T" and the wind information is put into a file named "SOUNDING.W". The complete program listing is attached in the Appendix.

The program runs in less than 10K memory, hence in Background of any WSO or WSFO AFOS computer while AFOS software runs in Foreground. The executable save file requires 13824 bytes of storage (or about 27 blocks) on a disk. The three RDOS files that it requires ("RAOB.BB" for input and "SOUNDING.T" and "SOUNDING.W" for output) occupy about 1750 bytes (about 3 blocks) of space.

```
      IF(DEPR(M) .GE. 55.0) DEPR(M)=DEPR(M)-50.0
C     CHECK FOR AN "=" SIGN DENOTING THE END
C     OF THE RAOB.
   91 N=N+2
      IF(IDATA(N) .EQ. 075K) GO TO 215
C     STRING SEARCH FOR THE FIRST INTEGER:
C     0 THRU 9.
      NP10=N+10
      DO 93 I=N,NP10
      DO 94 IJ=0,9
      IF((IDATA(I)-48) .EQ. IJ) GO TO 95
   94 CONTINUE
      N=N+1
   93 CONTINUE
      WRITE(10,3) N
      GO TO 215
C     CHECK TO SEE IF THIS IS THE NEXT LEVEL
C     GROUP OR IF IT IS THE END OF THE "TTBB"
C     SECTION OF THE RAOB; THE 51515 GROUP.
   95 IPOINT-IPOINT1
      IF(IPOINT .EQ. 10) IPOINT=1
      NP1=N+1
      NP2=N+2
      NP3=N+3
      NP4=N+4
      IF(IDATA(N) .EQ. 065K .AND. IDATA(NP1) .EQ.
      061K .AND.
    1 IDATA(NP2) .EQ. 065K .AND. IDATA(NP3) .EQ.
      061K .AND. IDATA(NP4)
    1 .EQ. 065K) GO TO 215
      IF((IDATA(N)-48) .NE. IPOINT .AND. (IDATA(NP1
      )-48) .NE. IPOINT)
    1 WRITE(10.3) N
      IF((IDATA(N)-48) .NE. IPOINT .AND. (IDATA(NP1)
      -48) .NE. IPOINT)
    1 GO TO 215
      M=M+1
C     RECYCLES THRU THE LOOP TO ASSIGN VALUES
C     AT THE NEW PRESSURE LEVEL.
      GO TO 80
C     STRING SEARCH FOR THE WIND SECTION OF
C     THE RAOB; "B""B"
C     "SPACE""SPACE".
  215 ISAVE=M
      NP20=N+20
      DO 200 I-N,NP20
      IF(IDATA(I) .NE. 102K) GO TO 206
      IP1=I+1
      IF(IDATA(IP1) .NE. 102K) GO TO 206
      IP2=I+2
      IF(IDATA(IP2) .NE. 040K) GO TO 206
      IP3=I+3
      IF(IDATA(IP3) .NE. 040K) GO TO 206
      N=N+4
      GO TO 201
  206 N=N+1
  200 CONTINUE
      WRITE(10.3) N
      GO TO 300
C     STRING SEARCH FOR THE BEGINNING OF THE
C     FIRST GROUP SPECIFYING THE WIND LEVELS;
C     A "SPACE""9".
  201 M=1
```

Disk access is much faster on a rigid disk drive than on a floppy disk drive. Hence, the program executes faster from a rigid disk (runtime about 17 seconds) than from a floppy disk (about 24 seconds). The input and output files must exist in the same directory as the executable save file.

An example of a second transmission of a raob SAVED in "RAOB.BB" from AFOS and the two resultant output files is shown i Figure 1. Both output files have the three digit station number, date, and time (Greenwich Mean Time) as the first line. The wind file lists the height level in thousands of feet and the wind direction and speed. The temperature file lists the pressure level, temperature and dewpoint depression (a depression of -1.0 indicates no depression reported).

4. APPLICATIONS

Many applications programs useful to the forecaster can be written to access the output of the decoder. At the Scientific Services Division (SSD), Western Region of the NWS, the first such application was simply a visual plot of the sounding information to be displayed on an AFOS graphics screen. Figure 2 is an example of this display. The plot itself takes only about 40 seconds on AFOS. This plot was made possible through the use of an AFOS graphics package written by SSD. A convective parameter routine is being written to determine the convective condensation level, convective temperature, lifted condensation level, level of free convection, and three stability indices (K, Showalter, and lifted index). Other routines for turbulence forecasting, for estimating precipitation type, and for estimating location and severity of icing are planned.

In addition to one being able to use the decoded raob information as input to other programs, this program should demonstrate the basic technique involved in decoding any meteorological product. There are probably more efficient

```
      NP10=N+50
      DO 205 I=N,NP10
      IP1=I+1
      IF(IDATA(I) .NE. 040K) GO TO 208
      IF((IDATA(IP1)-48) .NE. 9) GO TO 208
      GO TO 207
  208 N=N+1
  205 CONTINUE
      WRITE(10,3) N
      GO TO 300
C     ASSIGNS THE NEXT LEVEL OF WINDS GIVEN (IT
C     CHECKS FOR "/" FOR MISSING LEVELS.
  207 N=N+2
      NP1=N+1
      NP3=N+3
      MM=M
      DO 210 I=NP1,NP3
      IF(IDATA(I) .NE. 057K) ILVL(M)=(10*(IDATA(N)-48)
     )+(IDATA(I)-48)
      IF(IDATA(I) .NE. 057K) M=M+1
  210 CONTINUE
C     ASSIGNS THE WINDS AT THE ABOVE
      DETERMINED LEVELS.
      N=N+4
      M=M-1
      DO 220 II=MM,M
      NP10=N+10
      DO 211 I=N,NP10
      DO212 IJ=0,9
      IF((IDATA(I)-48) .EQ. IJ) GO TO 216
  212 CONTINUE
      N=N+1
  211 CONTINUE
      WRITE(10,3) N
      GO TO 300
  216 NP1=N+1
      NP2=N+2
      NP3=N+3
      NP4=N+4
      IDIR(II)=((IDATA(N)-48)*100)+((IDATA(NP1)-48)* 10
     )+(IDATA(NP2)-48)
      ISPEED(II)=((IDATA(NP3)-48)*10)+(IDATA(NP4)-48)
      N=N+5
  220 CONTINUE
C     CHECKS FOR END OF FILE; "="
      IF(IDATA(N) .EQ. 075K) GO TO 300
C     CHECK FOR NEXT "(9)" GROUP AND MAKES
C     SURE THAT ALL THE CHARACTERS IN THE
C     GROUP ARE INTEGERS OR A "/".
      NP10=N+10
      DO 230 I-N,NP10
      IF((IDATA(I)-48) .NE. 91 GO TO 229
      DO 232 IIJ-1,4
      DO 231 IJ-0,10
      JI-IIJ+I
      IF((IDATA(JI)-48).EQ. IJ .OR. IDATA (JI).EQ. 057K)
    1 GO TO 232
      IF(IJ .EQ. 10) WRITE(10,3) N
      IF(IJ .EQ. 10) GO TO 300
  231 CONTINUE
  232 CONTINUE
      GO TO 235
  229 N=N+1
```

methods than this, especially if one was to devise a standard string decoder that could be used in decoding any message. This has, however, proven to be reliable and is able to run in the limited 10K space available in a WSO Background in a short amount of time. This should also demonstrate the type of forecaster assistance programs that can help the forecaster analyze a lot of meteorological information in a small amount of time by having data extracted and processed directly from the AFOS system.

```
      230  CONTINUE
C          RECYCLES THRU THE LOOP TO ASSIGN THE
C          WINDS AT THE NEXT LEVELS.
      235  M-M+1
           N=N-1
           GO TO 207
C          WRITES THE DECODED TEMPERATURE
           INFORMATION INTO AN RDOS FILE NAMED
           "SOUNDING.T" AND THE DECODED WIND
           INFORMATION INTO AN RDOS FILE NAMED
           "SOUNDING.W".
      300  CALL DFILW("SOUNDING.T",TER)
           CALL CFTLW("SOUNDING.T",2,IER)
           CALL DFILW("SOUNDING.W",IER)
           CALL CFILW("SOUNDING.W".2,IER)
           CALL OPEN(7,"SOUNDING.T".2,IER)
           WRITE(7,304) ISTATN,IDATE,ITIME
      304  FORMAT(1X,13,1K,12,1X,T2)
           DO 310 I-1,ISAVE
           TF(IPRESS(I) .LT. 100) IPRESS(I)=IPRESS(I) + 1000
           WRITE(7,305) IPRESS(I), TEMP(I), DEPR(I)
      305  FORMAT(1X,I4,1X,F5,1,1X,F4,1)
      310  CONTINUE
           CALL OPEN(8,"SOUNDING.W",2,IER)
           WRITE(8,304)ISTATN,IDATE,ITIME
           DO 320 I-1,M
           WRITE (8,325) ILVL(I), IDIR(I), ISPEED(I)
      325  FORMAT(1X,12,1X,I3,I2)
      320  CONTINUE
           CALL CLOSE(6,IER)
           CALL CLOSE(7,IER)
           CALL CLOSE(8,IER)
           STOP
           END
```

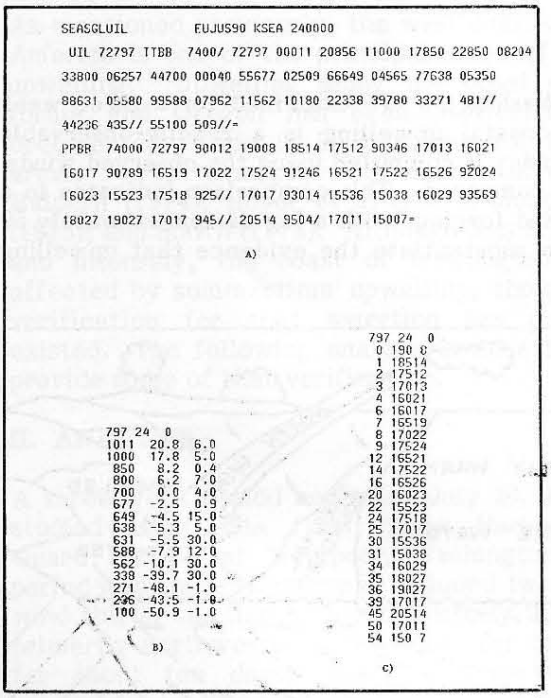

Figure 1. Shown are A) significant level data for Quillayute, Washington, B) corresponding SOUNDING.T and C) SOUNDING.W.

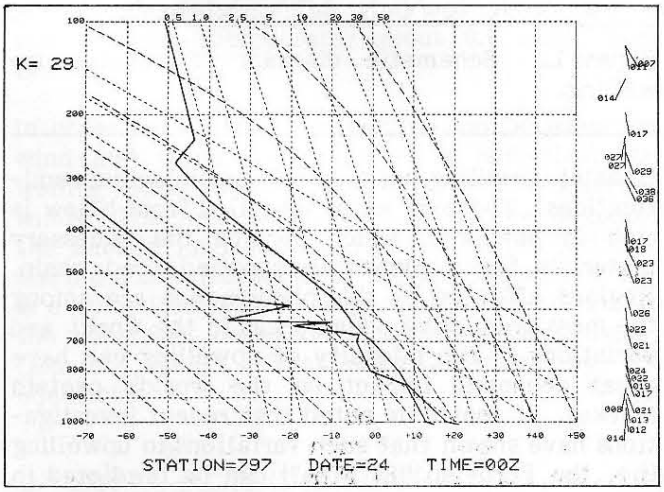

Figure 2. Hard copy of the Raob graphic display for AFOS developed at the Scientific Services Division, Western Region of the National Weather Service. The solid lines are the temperature and dewpoint profiles from the surface to 100 mb. The dotted lines are the reference pressure, temperature and mixed ratio contours used as a map background. The dashed curved lines are the adiabats. The wind information is plotted along a vertical axis on the right. The arrow points in the direction from which the wind is blowing and has the exact wind speed printed at the tail of the arrow. The K index has been calculated and is printed in the upper left corner.