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NOAA Western Region Computer Programs and Problems NWS WRCP - No. 14

LIGHTNING ACTIVITY LEVELS

National Weather Service Western Region
Salt Lake City, Utah
July 1980

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service

This Western Region publication series is considered as a subset of our Technical Memorandum series. This series will be devoted exclusively to the exchange of information on and documentation of computer programs and related subjects. This series was initiated because it did not seem appropriate to publish computer program papers as Technical Memoranda; yet, we wanted to share this type of information with all Western Region forecasters in a systematic way. Another reason was our concern that in the developing AFOS-era there will be unnecessary and wasteful duplication of effort in writing computer programs in National Weather Service (NWS). Documentation and exchange of ideas and programs envisioned in this series hopefully will reduce such duplication. We also believe that by publishing the programming work of our forecasters, we will stimulate others to use these programs or develop their own programs to take advantage of the computing capabilities AFOS makes available.

We solicit computer-oriented papers and computer programs from forecasters for us to publish in this series. Simple and short programs should not be prejudged as unsuitable.

The great potential of the AFOS-era is strongly related to local computer facilities permitting meteorologists to practice in a more scientific environment. It is our hope that this new series will help in developing this potential into reality.

1 Standardized Format for Computer Series.
2 AFOS Crop and Soil Information Report Program. Ken Mielke, July 1979.
3 Decoder for Significant Level Transmissions of Roabs. John A. Jannuzzi, Aug. 1979.
4 Precipitable Water Estimate. Elizabeth Morse, October 1979.
5 Utah Recreational Temperature Program. Kenneth M. Labas, November 1979.
6 Normal Maximum/Minimum Temperature Program for Montana. Kenneth Mielke, Dec.1979.
7 Plotting of Ocean Wave Energy Spectral Data. John R. Zimmerman, December 1979.
8 Raob Plot and Analysis Routines. John Jannuzzi, January 1980.
9 The SWAB Program. Morris S. Webb, Jr. April 1980.
10 Flash-Flood Procedure. Donald P. Laurine and Ralph C. Hatch, April 1980.
11 Program to Forecast Probability of Summer Stratus in Seattle Using the Durst Objective Method. John Zimmerman, May 1980.
12 Probability of Sequences of Wet and Dry Days. Hazen H. Bedke, June 1980.
13 Automated Montana Hourly Weather Roundup. Joe L. Johnston, July 1980.

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LIGHTNING ACTIVITY LEVELS

Mark A. Mollner
Weather Service Forecast Office
Boise, Idaho
July, 1980

UNITED STATES
DEPARTMENT OF COMMERCE
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ATMOSPHERIC ADMINISTRATION
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National Weather
Service
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FIGURES

LIGHTNING ACTIVITY LEVELS

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I. General Information

A. Summary:

This program computes Lightning Activity Level (LAL) and J.R. Sims cloud cover (SCC) forecasts for the Western United States. The resultant LAL/SCC forecast map can be used routinely in the briefing of Land Management Agencies at BIFC (Boise Interagency Fire Center). Western Region Fire Weather forecasters will recognize that this LAL/SCC forecast map is essentially the same as was distributed on RAFAX a few years ago.

B. Environment

The program is written in Data General Fortran IV. For computation of the LAL/SCC forecast, a small amount of edit work to one RDOS file on an AFOS ADM is needed. However, once AFOS is fully operational, this step can be performed by the AFOS minicomputer.

C. References:

McCoy, James J. and Gift, Frank C., 1974: A Method for Forecasting Lightning Risk in the Boise Fire Weather District for the National Fire Danger Rating System. Paper presented at the Third National Conference on Fire and Forest Meteorology of the American Meteorological Society and the Society of American Foresters. National Weather Service, WSFO Boise, 46 pp.

II. Application

A. Complete Program Description

Before the LAL/SCC forecast program is run, two programs that produce the Western U.S. map background and plot the station identifiers must be run. The Western Region Graphics library is used to do this (To be described in a future WRCP). The RDOS file, 'WRNMAP1', contains the Western U.S. map background while the RDOS file, 'WRNPLOT', contains the station identifiers. The map produced is not exactly to scale or in great detail, but it is sufficient for our needs.

The program to compute the LAL/SCC forecasts, MMLALFW2, requires the editing of 'STATFILE' which is located in the AFOS data base. An example is shown in Figure 1. The K-Index stability value can be entered in one of three ways: 1) By using the K-trajectory forecast from the FOUS 50 series and interpolating for those stations without a K trajectory forecast; 2) By drawing the forecast trajectories on an observed K chart and advecting the upstream K to each station; 3) By using the observed K values from the morning RAOBS and interpolating the other K values, with the use of satellite pictures and the awareness of moisture and weather system movement, for the non-RAOB stations. The R1, R2, R3, V1, V2, V3 values are the six hour relative humidity and vertical velocity forecasts for the daylight hours of the forecast day from the FOUS 70 series LFM forecasts. The "MONTH" portion of the file must contain the proper number so that the right set of equations will be used to compute the LAL's. Once AFOS is fully operational, a program will be written to edit this file automatically.

The program beings by setting up the AFOS graphic for plotting the output on an AFOS GDM and by dimensioning the necessary arryas. Array 'XCC' contains the computed LAL/SCC forecasts; array 'ICC' contains cloud cover forecasts for the fifteen non-FOUS stations which are averaged from the surrounding FOUS SCC forecasts; array 'PKM' accepts cloud cover data from RDOS file, 'CLDFILE' (see referenced publication), which is used to adjust the K value at the non-FOUS stations; and array 'LPT' contains plotting coordinates for the computed LAL/SCC forecasts which are called from RDOS file, 'LPTFILE' (figure 2).

The program then reads the proper month, M, from 'STATFILE' and accepts the first line of data. The SCC forecast is made and based on the proper month, M, the LAL forecast is computed. This is repeated for the 25 FOUS stations. Using the 'ICC' array, LAL's are computed for the 15 non-FOUS stations. These LAL/SCC forecasts are read into the 'XCC' array. Next, the program returns to the AFOS graphics package. RDOS file, 'LPTFILE', is opened and the coordinates for plotting the computed LAL/SCC forecasts are read into the 'LPT' array. A 'DO' loop processes these through the 'CALL TEXT .. .' graphic subroutine. A legend and map title are also processed through this subroutine. Finally, all information is stored in the 'LALPLOT' file for display on a GDM.

B. Machine Requirements

The program runs in 12K of memory. The three files use three channels and take up 1,773 bytes. The actual run time for the program is 30 seconds.

C. Data Base

A list and brief description of all files used follows:

FILE	CREATION	BRIEF DESCRIPTION
STATFILE	You create & edit	K-index, humidities, vertical velocities, month
CLDFILE	You create	K cloud cover correction for non-FOUS stations
LPTFILE	You create	Coordinates for LAL/SCC data plot on GDM
LALPLOT	Program creates	LAL/SCC data plot on GDM

II. Procedures

A. Initiation of Program/B. Input Requirements:

After editing 'STATFILE' as covered in section II-A, this file is saved, the program is run, and the final map product is displayed on an AFOS GDM via an AFOS ADM Procedure named "LAL". This Procedure is shown in Figure 3.

C. Output

The above Procedure displays the final product on an AFOS GDM. A sample is shown in Figure 4. A copy of this is made on the Printer/Plotter for use in briefings. A quick hand analysis delineates the different LAL categories.

D. Cautions and Restrictions

All program and file data are run and stored on a floppy disk. The floppy disk is referred to through Directory DP1. That is why all open channels and SAVE and RUN commands refer to DP1.

On the final map product, the LAL definitions are abbreviated.

E. Program Listing

(See pages following the figures)

ACKNOWLEDGEMENTS

Special appreciation is extended to Pete Mueller for his help in debugging the program and to Jerry Burdwell and Jim Fors for their useful comments.

ARCHIVE COPY:
STATFILE
WOUS00 KBOI 201729

STATION	K	R1	R2	R3	VV1	VV2	VV3
SEA--793	05	25	29	22	006	004	-02
GEG--785	15	99	99	94	017	013	-23
GTF--775	10	27	20	26	016	002	2
MSO--773	22	91	92	99	016	009	-12
BIS--764	25	59	61	60	002	003	-02
PDX--698	25	85	76	69	011	034	-34
BIL--677	18	64	72	77	011	012	-33
BOI--681	28	16	20	24	-33	-34	-02
RAP--662	19	47	53	63	54	34	-34
PIH--578	32	86	89	90	06	007	009
MFR--597	30	64	73	67	12	12	10
CYS--564	10	26	38	23	-21	11	-23
LBF--562	15	66	68	58	-30	11	-02
SLC--572	35	95	92	98	-23	12	-09
RNO--488	30	84	81	67	23	-05	-08
DEN--469	22	75	85	93	12	-09	-99
SFO--494	15	23	33	21	12	-01	-56
CDC--475	37	20	10	30	17	18	18
DDC--451	23	22	22	22	12	12	12
FAT--389	28	68	67	56	01	001	-12
ABQ--365	08	18	13	28	014	-09	012
LAX--295	24	63	63	61	-12	-09	-12
PHX--278	35	75	65	62	22	22	-03
LBB--267	02	26	38	35	-23	-23	-05
ELP--270	34	14	20	24	-12	-12	-12

STATION	K
UIL--797	20
GGW--768	20
YKM--781	15
SLE--694	23
LND--576	20
WMC--583	33
ELY--486	40
GJT--476	20
ALS--462	25
UCC--385	22
SMX--394	24
INW--374	35
AMA--363	20
SAN--290	25
TUS--274	30

MONTH=3
JUNE=1
JULY=2
AUG=3
SEPT=4

```
LPTFILE
WOUS00 KBOI 121548
236,818,1550,1230,2720,240,1860,960,2480,1400,280,2300,
2840,1440,565,2305,116,1240,2920,530,2120,530,1420,2780,
2200,115,2150,350,200,1820,760,1080,1880,2220,920,390,
1650,2780,716,1590,2692,2580,2610,2460,2490,2275,2200,
1900,1930,1750,1707,1485,1445,1420,1265,1300,1020,945,
975,775,625,335,325,345,110,2790,2705,2425,2125,1730,
1525,1230,1205,325,775,525,560,625,164,125
```

```
CLDFILE
WOUS00 KBOI 061718
0,1,2,3,4,5,6,7,8,9,10,-6,-4,-3,-1,1,3,5,7,9,11,12,-8,-5,-2,1,5,8,
11,15,18,21,22,-5,-3,-1,1,4,6,8,10,12,14,16,-5,-3,-1,0,2,4,6,7,9,
11,13
```

PAGE 01

FIGURE 2 -- LPTFILE and CLDFILE

```
BOIPCD004
WDUS00 KBOI 142044
  DISPLAY   MODE  ACC/OV    COMMAND
   (1-4)    (D/M) (R/A/O)   (ANY COMMAND; LAST LINE MUST BE END OR "NAME")
  -------   ----- -------   ----------------------------------------------
01   1        D      R       SAVE:STATFILE   DP1:STATFILE
02   1        D      R       RUN:DP1:MMLALFW2
03   1        D      R       PAUSE 40
04   2        D      O       DSP:DP1:WRNMAP1
05   2        D      O       DSP:DP1:WRNPLOT
06   2        D      O       DSP:DP1:LALPLOT
07   1        D      R       END
08
09
10
11
12
13
14
15
16
17
18
 ]      [                              ]              [ ]
                                                              PAGE 01
```

FIGURE 3 -- "LAL" Procedure

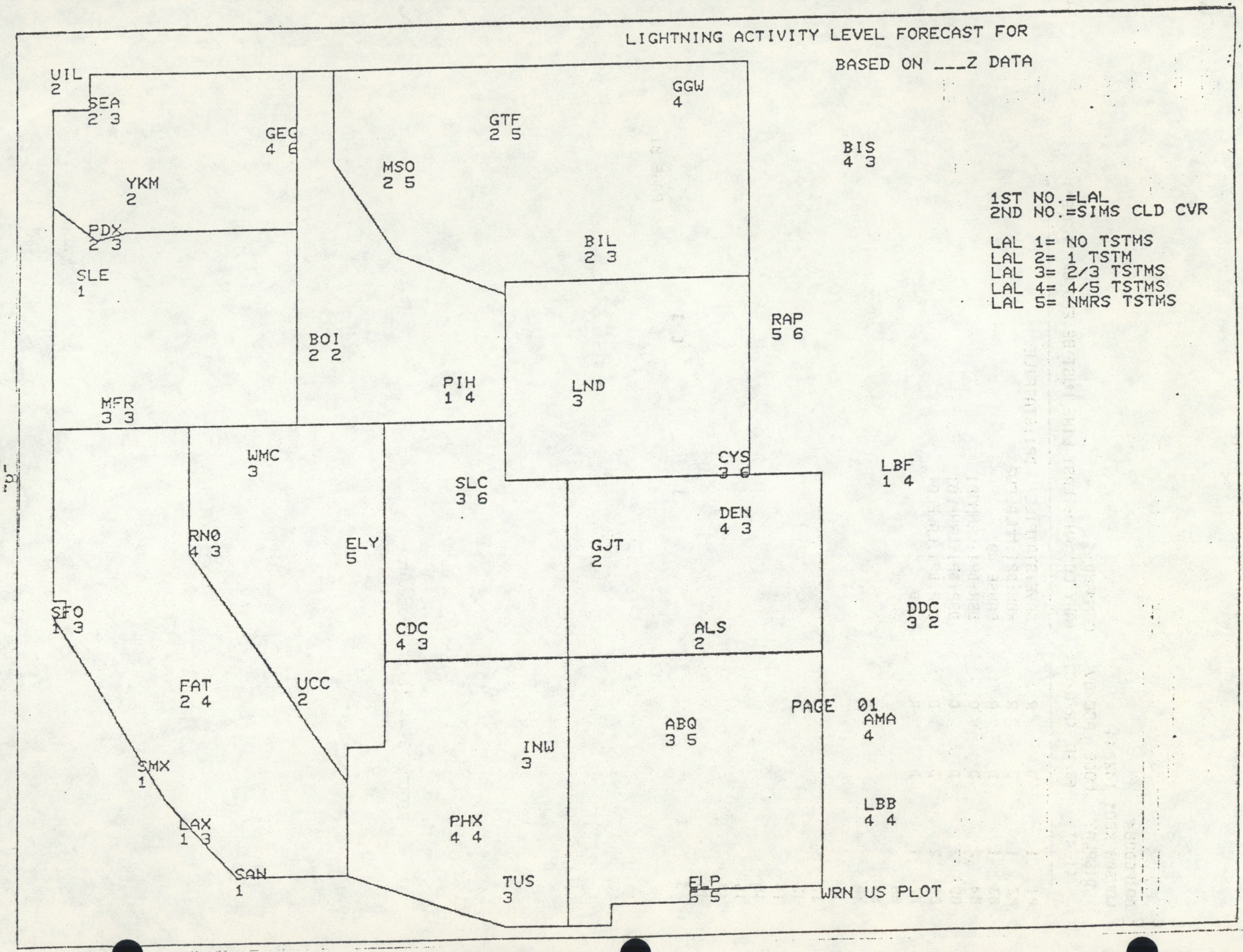

FIGURE 4 -- Final Map Product from Printer/Plotter. LAL definitions are abbreviated.

```
C       THIS PROGRAM COMPUTES LIGHTNING ACTIVITY LEVEL FORECASTS
C       AND SIMS CLOUD COVER FORECASTS
C       AND PLOTS THEM ON A GDM DISPLAY
C       PROGRAM NAME...MMLALFW2
      PARAMETER NS=512,NS2=1024
      DIMENSION IGA(NS),IB(NS2),IT(100)
      DIMENSION XCC(40,2),PKM(0:10,5),ICC(15),LPT(40,2)
      IT(1)="NM"
      IT(2)="CG"
      IT(3)="PH"
      IT(4)="MM"
      IT(5)="3 "
      CALL COMMH(IGA,IT,NW,NS)
      IFLG=0
      CALL GPD1(IGA,NW,NS,IFLG)
      NSIZE=1
C     OPEN STATFILE,READ IN MONTH NUMBER,COMPUTE LAL/SCC FOR FOUS STATIONS
      CALL OPEN (2,"DP1:STATFILE",2,IER,1024)
      READ (2,2) M
2     FORMAT (/57X,I1)
      DO 40 I=1,25,1
      READ(2,5) K,M1,M2,M3,L1,L2,L3
5     FORMAT (9X,4(I2,1X),3(I3,1X))
      M4=((M1+M2+M3)/3)+.5
      L4=((L1+L2+L3)/3)+.5
      N=0
      IF(M3-M2.LT.-10)N=-1
      IF(M3-M2.GT.10)N=1
      CC=((.07*M4)+(.007*L4)+(.77*N)+.5)
      GOTO(21,23,25,27),M
21    FLAL=((.037*K)+(.013*M4)+(.014*L4)+(.144*N)+.03)+.5
      GOTO 30
23    FLAL=((.058*K)+(.016*M4)+(.017*L4)+(.17*N)+.75)+.5
      GOTO 30
25    FLAL=((.039*K)+(.013*M4)+(.015*L4)+(.146*N)+.15)+.5
      GOTO 30
27    FLAL=((.059*K)+(.007*M4)+(.003*L4)+(.08*N)+.77)+.5
30    IF(FLAL.LT.1)FLAL=1
      IF(FLAL.GT.6)FLAL=5
      JJ=FLAL
      XCC(I,1)=JJ
      XCC(I,2)=CC
40    CONTINUE
C     ASSIGN SCC FORECASTS FOR NON-FOUS STATIONS
      ICC(1)=XCC(1,2)
      ICC(2)=(XCC(5,2)+XCC(3,2))/2
      ICC(3)=XCC(2,2)
      ICC(4)=XCC(6,2)
C
      ICC(5)=(XCC(10,2)+XCC(15,2)+XCC(7,2))/3
      ICC(6)=(XCC(8,2)+XCC(15,2))/2
      ICC(7)=(XCC(14,2)+XCC(18,2))/2
      ICC(8)=(XCC(16,2)+XCC(14,2)+XCC(18,2))/3
      ICC(9)=(XCC(21,2)+XCC(16,2))/2
      ICC(10)=XCC(18,2)
```

```
      ICC(11)=XCC(22,2)
      ICC(12)=(XCC(23,2)+XCC(18,2))/2
      ICC(13)=(XCC(21,2)+XCC(19,2))/2
      ICC(14)=XCC(22,2)
      ICC(15)=(XCC(23,2)+XCC(25,2))/2
C     READ IN K CORRECTION VALUES FROM CLDFILE
C     COMPUTE LAL FOR NON FOUS STATIONS

      CALL OPEN(3,"DP1:CLDFILE",2,IER,512)
      READ(3)((PKM(I,J),I=0,10,1),J=1,5,1)
      REWIND 2
      READ (2,3)
3     FORMAT(/)
      DO 105 N=26,40,1
      READ (2,50) KK
50    FORMAT(45X,I2)
      KD=PKM(ICC(N-25),M+1)
      KM=KK+KD
C
C
      GOTO(60,70,80,90),M
C
60    IF(KM.LE.8)GOTO 95
      IF(KM.GE.9 .AND. KM.LE.18)GOTO 96
      IF(KM.GE.19 .AND. KM.LE.28)GOTO 97
      IF(KM.GE.29 .AND. KM.LE.39)GOTO 98
      GOTO 99
70    IF(KM.LE.2)GOTO 95
      IF(KM.GE.3 .AND. KM.LE.17)GOTO 96
      IF(KM.GE.18 .AND. KM.LE.31)GOTO 97
      IF(KM.GE.32 .AND. KM.LE.46)GOTO 98
      GOTO 99
80    IF(KM.LE.9)GOTO 95
      IF(KM.GE.10 .AND. KM.LE.21)GOTO 96
      IF(KM.GE.22 .AND. KM.LE.32)GOTO 97
      IF(KM.GE.33 .AND. KM.LE.43)GOTO 98
      GOTO 99
90    IF(KM.LE.7)GOTO 95
      IF(KM.GE.8 .AND. KM.LE.23)GOTO 96
      IF(KM.GE.24 .AND. KM.LE.40)GOTO 97
      IF(KM.GE.41 .AND. KM.LE.57)GOTO 98
      GOTO 99
C
95    LAL=1
      GOTO 100
96    LAL=2
      GOTO 100
97    LAL=3
      GOTO 100
98    LAL=4
      GOTO 100
99    LAL=5
100   XCC(N,1)=LAL
      XCC(N,2)=0
105   CONTINUE
```

```
C  PLOT COMPUTED VALUES FOR LAL AND CLOUD COVER
C
      CALL OPEN(4,"DP1:LPTFILE",2,IER,800)
      READ(4)((LPT(I,J),I=1,40,1),J=1,2)
      DO 165 I=1,40,1
      IL=LPT(I,1)
      JL=LPT(I,2)
      LL=XCC(I,1)
      GOTO(110,112,114,116,118),LL
C
110   IT(1)="1 "
      GOTO 120
112   IT(1)="2 "
      GOTO 120
114   IT(1)="3 "
      GOTO 120
116   IT(1)="4 "
      GOTO 120
118   IT(1)="5 "
120   IF(I.GE.26)GOTO 150
      JC=XCC(I,2)+1
      GOTO(122,124,126,128,130,132,134,136,138,140,142),JC
122   IT(2)="0 "
      GOTO 145
124   IT(2)="1 "
      GOTO 145
126   IT(2)="2 "
      GOTO 145
128   IT(2)="3 "
      GOTO 145
C
130   IT(2)="4 "
      GOTO 145
132   IT(2)="5 "
      GOTO 145
134   IT(2)="6 "
      GOTO 145
136   IT(2)="7 "
      GOTO 145
138   IT(2)="8 "
      GOTO 145
140   IT(2)="9 "
      GOTO 145
142   IT(2)="10"
145   IT(3)=0
      GOTO 160
150   IT(2)=0
160   CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
165   CONTINUE
C     PRINT MAP LEGEND
      IL=2000
      JL=2920
      IT(1)="LI"
      IT(2)="GH"
      IT(3)="TN"
      IT(4)="IN"
      IT(5)="G "
      IT(6)="AC"
      IT(7)="TI"
      IT(8)="VI"
      IT(9)="TY"
```

```
IT(10)=" L"
IT(11)="EV"
IT(12)="EL"
IT(13)=" F"
IT(14)="OR"
IT(15)="EC"
IT(16)="AS"
IT(17)="T "
IT(18)="FO"
IT(19)="R "
IT(20)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=2700
JL=2820
IT(1)="BA"
IT(2)="SE"
IT(3)="D "
IT(4)="ON"
IT(5)=" ←"
IT(6)="←←"
IT(7)="Z "
IT(8)="DA"
IT(9)="TA"
IT(10)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=3200
JL=2365
IT(1)="1S"
IT(2)="T "
IT(3)="NO"
IT(4)=".="
IT(5)="LA"
IT(6)="L "
IT(7)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=3200
JL=2315
IT(1)="2N"
IT(2)="D "
IT(3)="NO"
IT(4)=".="
IT(5)="SI"
IT(6)="MS"
IT(7)=" C"
IT(8)="LD"
IT(9)=" C"
IT(10)="VR"
IT(11)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=3200
JL=2215
IT(1)="LA"
IT(2)="L "
IT(3)="1="
IT(4)=" N"
IT(5)="O "
IT(6)="TS"
IT(7)="TM"
IT(8)="S "
IT(9)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
```

```
IL=3200
JL=2165
IT(1)="LA"
IT(2)="L "
IT(3)="2="
IT(4)=" 1"
IT(5)=" T"
IT(6)="ST"
IT(7)="M "
IT(8)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=3200
JL=2115
IT(1)="LA"
IT(2)="L "
IT(3)="3="
IT(4)=" 2"
IT(5)="/3"
IT(6)=" T"
IT(7)="ST"
IT(8)="MS"
IT(9)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=3200
JL=2065
IT(1)="LA"
IT(2)="L "
IT(3)="4="
IT(4)=" 4"
IT(5)="/5"
IT(6)=" T"
IT(7)="ST"
IT(8)="MS"
IT(9)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
IL=3200
JL=2015
IT(1)="LA"
IT(2)="L "
IT(3)="5="
IT(4)=" N"
IT(5)="MR"
IT(6)="S "
IT(7)="TS"
IT(8)="TM"
IT(9)="S "
IT(10)=0
CALL TEXT(NSIZE,IGA,IL,JL,IT,NW,NS)
CALL UTF("DP1:LALPLOT",IGA,IB,NW,NS,NS2)
CALL RESET
STOP
END
```

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