U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER

OFFICE NOTE 303

Skill of Medium Range Forecast Group

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FEBRUARY 1985

PURPOSE

This paper depicts in a graphical manner the skill of the Medium Range (3-10 day) Forecast Group (MRFG) man and machine (numerical model guidance) forecasts. It will be updated each February in order to present the latest scores for each of the several forecast categories in the MRFG. Only scores with at least a 5-year period of record are presented. This paper contains the standardized and unstandardized mean sea-level pressure and 500-mb correlation; the Gilman, Hughes and experimental precipitation skill; the minimum/maximum absolute temperature error; and the 5-day mean normalized 500-mb correlation, temperature, and precipitation skill scores.

Numerical Model Guidance (Past to Present)

1. Acronyms

   a. Baro - Reed Barotropic Advection Model Hemispheric
   b. 6L PE - 6-layer Primitive Equation Model Hemispheric
   c. CM - Course Mesh 380km FM - Fine Mesh 190km
   d. SMG26 - Spectral Model Global 24 modes 6-layers
   e. SMH2C - Spectral Model Hemispheric 24 modes 12-layers
   f. SMG3C - Spectral Model Global 30 modes 12-layers
   g. SMG4C - Spectral Model Global 40 modes 12-layers

2. 00Z Guidance

   a. To 84-hours

      (1) From 1970 through 1977: 6L PE CM
      (2) From 1978 through 1979: 7L PE FM
      (3) From January 1980 to August 15, 1980: 7L PE FM to 60-hours then 7L PE CM with Fourth Order Differencing to 84-hours.
      (4) From August 15, 1980, to April 15, 1981: SMG3C to 48-hours then SMH2C to 84-hours
      (5) From April 15, 1981, through October 19, 1983: SMG3C to 48-hours then SMG2C to 84-hours.
      (6) From October 19, 1983,through December 1984: SMG4C

   b. Greater than 84-hours to 144-hours

      (1) From 1970 through 1979: Baro (Mesh 1977-1979)
      (2) From January 1980 to August 15, 1980: 7L PE CM with Fourth Order Differencing.
      (3) From August 15, 1980 to April 15, 1981: SMH2C
      (4) From April 15, 1981, through April 1982: SMG26
      (5) From May 1982 through October 19, 1983: SMG2C
      (6) From October 19, 1983 through December 1984: SMG4C

   c. Greater than 144-hours to 252 hours

      (1) From November 1977 through April 1981: Baro Mesh
      (2) From December 1977 through April 15, 1981: 3L PE CM
      (3) From April 15, 1981 through October 19, 1983: SMG26 to 192 hours then SMH26 to 240 hours.
      (4) From October 19, 1983 through December 1984: SMG4C to 240 hours.

3. 12Z Guidance

   a. To 60-hours

      (1) From 1970 through 1977: 6L PE CM

   b. Greater than 60-hours to 96-hours (500mb only):

      (1) From 1970 through 1977: Baro (Mesh in 1977)

c. To 48-hours

(1) From October 1971 through August 1977: 7L PE FM (old LFM)
(2) From September 1977 through 1984: 7L PE LFM (127km)

d. Greater than 48-hours to 120 hours (500mb only)

(1) From 1978 through 1984: Baro run from the 48-hour LFM inserted into the 60-hour SMG4C from 00Z.

Forecast Day	Day 1	Day 2	Day 3	Day 4	Day 5
12Z	12Z	12Z	12Z	12Z	12Z
12hrs	36hrs	60hrs	84hrs	108hrs	132hrs

00Z 00Z 00Z 00Z 00Z 00Z 00Z

← SMG4C →

← 48hr LFM → ← BARO →

Day 6	Day 7	Day 8	Day 9	Day 10
12Z	12Z	12Z	12Z	12Z
156hrs	180hrs	204hrs	228hrs	252hrs

00Z 00Z 00Z 00Z 00Z 00Z

← SMG4C →

*NOTE OI ANALYSIS REPLACED THE HUF IN LATE JULY 1984.

Figures

Figure 1 depicts the North American (NA 130 grid points) and the United States (US 86 grid points) subset mean sea level pressure (MSLP) and 500 mb correlation score verification areas.

Figure 2 is a plot of the calendar year 1984 monthly mean standardized correlation scores for the man and NMC/NWP model North American area mean sea-level pressure progs verifying on days 3, 4, and 5 after forecast day. (See Appendix A for an explanation of this score.)

Figure 3 is a plot of the 17/15 year (1968/70-1984) average monthly mean standardized correlation scores for the man and NMC/NWP model North American area mean sea-level pressure progs verifying on days 3, 4, and 5 after forecast day. (See Appendix A for an explanation of this score.)

Figure 4 is a plot of the 1968/70 through 1984 calendar year standardized correlation scores for the man and NMC/NWP model North American area mean sea-level pressure progs verifying on days 3, 4, and 5 after forecast day. (See Appendix A for an explanation of this score.)

Figure 5 is similar to figure 2 except the score is unstandardized.

Figure 6 is similar to figure 3 except the average is for 8 years and the score is unstandardized.

Figure 7 is similar to figure 4 except the calendar years are 1977 through 1984 and the score is unstandardized.

Figure 8 is a plot of the calendar year 1984 monthly mean standardized correlation scores for the NMC/NWP model North American area 500-mb progs verifying on days 3, 4, and 5 after forecast day. (See Appendix A for an explanation of this score.)

Figure 9 is a plot of the 15 year (1970-1984) average monthly mean standardized correlation scores for the NMC/NWP model North American area 500-mb progs verifying on days 3, 4, and 5 after forecast day. (See Appendix A for an explanation of this score.)

Figure 10 is a plot of the 1970 through 1984 calendar year standardized correlation scores for the NMC/NWP model North American area 500-mb progs verifying on days 3, 4, and 5 after forecast day. (See Appendix A for an explanation of this score.)

Figure 11 is similar to figure 2 except the area is the United States.

Figure 12 is similar to figure 3 except the average is for 9 years and the area is the United States.

Figure 13 is similar to figure 4 except the calendar years are 1976 through 1984 and the area is the United States.

Figure 14 is similar to figure 5 except the area is the United States.

Figure 15 is similar to figure 6 except the area is the United States.

Figure 16 is similar to figure 7 except the area is the United States.

Figure 17 is similar to figure 8 except the area is the United States.

Figure 18 is similar to figure 9 except the average is for 10 years and the area is the United States.

Figure 19 is similar to figure 10 except the calendar years are 1975 through 1984 and the area is the United States.

Figure 20 is a plot of the calendar year 1984 monthly mean standardized correlation scores for the man, NMC/NWP model, European Center for Medium Range Weather Forecasting (ECMWF), and Linear Regression (LR - see NMC ON 259 of June 82) North American area 500-mb mean progs verifying 6 to 10 days after forecast day.

Figure 21 is a plot of the 6 year (1979-1984) average monthly mean standardized correlation scores for the man and NMC/NWP model North American area 500-mb progs verifying 6 to 10 days after forecast day.

Figure 22 is a plot of the 1979 through 1984 calendar year standardized correlation scores for the man, NMC/NWP model and ECMWF (1982-1984) North American area 500-mb mean progs verifying 6 to 10 days after forecast day.

Figure 23 depicts the 41 stations in the United States where the temperature forecasts are verified.

Figure 24(a,b,c) is a plot of the calendar year 1984 bi-monthly mean absolute error minimum temperature scores for the man, Klein Lewis (KL) objective, and climatology temperature forecasts verifying on days 3, 4, and 5 after forecast day.

Figure 25(a,b,c) is a plot of the 14 year (1971-1984) average bi-monthly mean absolute error minimum temperature scores for the man, KL, and climatology temperature forecasts verifying on days 3, 4, and 5 after forecast day.

Figure 26 is a plot of the 1971 through 1984 calendar year absolute error minimum temperature scores for the man, KL, and climatology temperature forecasts verifying on days 3, 4, and 5 after forecast day.

Figure 27(a,b,c) is similar to figure 24(a,b,c) except the temperature is maximum.

Figure 28(a,b,c) is similar to figure 25(a,b,c) except the temperature is maximum.

Figure 29 is similar to figure 26 except the temperature is maximum.

Figure 30 is a plot of the 1972 through 1984 calendar year absolute error (minimum + maximum) ÷ 2 temperature scores for the man, KL, and climatology temperature forecasts verifying on days (3+4+5) ÷ 3 after forecast day.

Figure 31 is a plot of the calendar year 1984 monthly mean 5-class temperature skill scores for the man, forecast persistence (FP - persistence of the 1-5 day mean temperature forecast as a 6-10 day), linear regression (LR - see NMC ON 259 of June 82), and observed (T OBS-persistence of the 5 day mean observed temperatures as a 6-10 day forecast) mean temperature forecasts verifying 6 to 10 day after forecast day. (See Appendix B for an explanation of this score.)

Figure 32 is a plot of the 7 year (1978-1984) average monthly mean 5 class temperature skill scores for the man, FP, LR and T OBS mean temperature forecasts verifying 6 to 10 days after forecast day.

Figure 33 is a plot for the 1978 through 1984 calendar year 5-class temperature skill scores for the man, FP, LR and T OBS mean temperature forecasts verifying 6 to 10 days after forecast day.

Figure 34 is similar to figure 31 except the temperature skill scores are 3-class.

Figure 35 is similar to figure 32 except the temperature skill scores are 3-class.

Figure 36 is similar to figure 33 except the temperature skill scores are 3-class.

Figure 37 depicts the 100 stations in the United States where the precipitation forecasts are verified.

Figure 38 is an example of a day 3, 4, or 5 precipitation forecast. The dashed lines are the 24-hour departure from normal probability of precipitation (DN POP) forecast for January 3. The solid lines are the 24-hour climatological (normal) probability of precipitation (NPOP) for the first 15 days of January. A total of (DN POP + NPOP) $\gtrsim 30$ is considered "yes" forecast of precipitation ($\gtrsim .01$ inch). All stations with an (NPOP)$\gtrsim$30 are considered as a "yes" climatological forecast of precipitation.

Figure 39 is a plot off the calendar year 1984 monthly mean Gilman precipitation skill scores for the man, climatology, and NMC/NWP model precipitation forecasts verifying on days 3, 4, and 5 after forecast day. (See Appendix C for an explanation of this score.)

Figure 40 is a plot of the 15 year (1970-1984) average monthly mean Gilman precipitation skill scores for the man and climatology precipitation forecasts verifying on days 3, 4, and 5 after forecast day.

Figure 41 is a plot of the 1970 through 1984 calendar year Gilman precipitation skill scores for the man and climatology precipitation forecasts verifying on days 3, 4, and 5 after forecast day.

Figure 42 is a plot of the 1970 through 1984 Gilman precipitation skill scores for the man and climatology precipitation forecasts verifying on days (3+4+5) ÷ 3 after forecast day.

Figure 43 is similar to figure 39 except the skill score is Hughes. (See Appendix D for an explanation of this score.)

Figure 44 is similar to figure 40 except the average is for 8 years, the skill score is Hughes, and climatology is not depicted.

Figure 45 is similar to figure 41 and figure 42 except the calendar years are 1977 through 1984 and the skill score is Hughes.

Figure 46 is similar to figure 39 except the skill score is Hughes Probability. (See Appendix E for an explanation of this score.)

Figure 47 is similar to figure 40 except the average is for 7 years and the skill score is Hughes Probability.

Figure 48 is similar to figure 41 and figure 42 except the calendar years are 1978 through 1984 and the skill score is Hughes Probability.

Figure 49 is a plot of the calendar year 1984 monthly mean 3-class precipitation skill scores for the man, NWP/NMC model and climatology mean precipitation forecasts verifying 1 to 5 days after forecast day. (See Appendix F for an explanation of this score.)

Figure 50 is a plot of the 7 year (1978-1984) average monthly mean 3-class precipitation skill scores for the man and climatology mean precipitation forecasts verifying 1 to 5 days after forecast day.

Figure 51 is a plot of the 1978 through 1984 calendar year 3-class precipitation skill scores for the man, NMC/NWP model and climatology mean precipitation forecasts verifying 1 to 5 days after forecast day.

Figure 52 is similar to figure 49 except the observed (P OBS - persistence of the 5-day mean observed precipitation as a 6-10 day forecast) is depicted and the forecast is for 6 to 10 days.

Figure 53 is similar to figure 50 except the forecast is for 6 to 10 days.

Figure 54 is similar to figure 51 except the forecast is for 6 to 10 days.

Figures 55 through 66 and 67 through 78 are plots of the calendar year 1984 monthly mean unstandardized/standardized correlation scores for the man, LFM, ECMWF, LR, NMC/NWP model and climatology North American area mean sea-level pressure progs verifying on days 1 through 9 after forecast day.

Figures 79 through 90 are plots of the calendar year 1984 monthly mean standardized correlation scores for the LFM, LR, ECMWF, and NMC/NWP model North American area 500-mb progs verifying on days 1 through 9 after forecast day.

Figures 91 through 102 are plots of the calendar year 1984 absolute error minimum and maximum temperature scores for the man, KL, LR and climatology temperature forecasts verifying on days 1 through 7 after forecast day.

SECTION 1

Man & Machine (NMC/NWP Guidance)

Mean Sea Level Pressure and 500 MB Correlation Scores

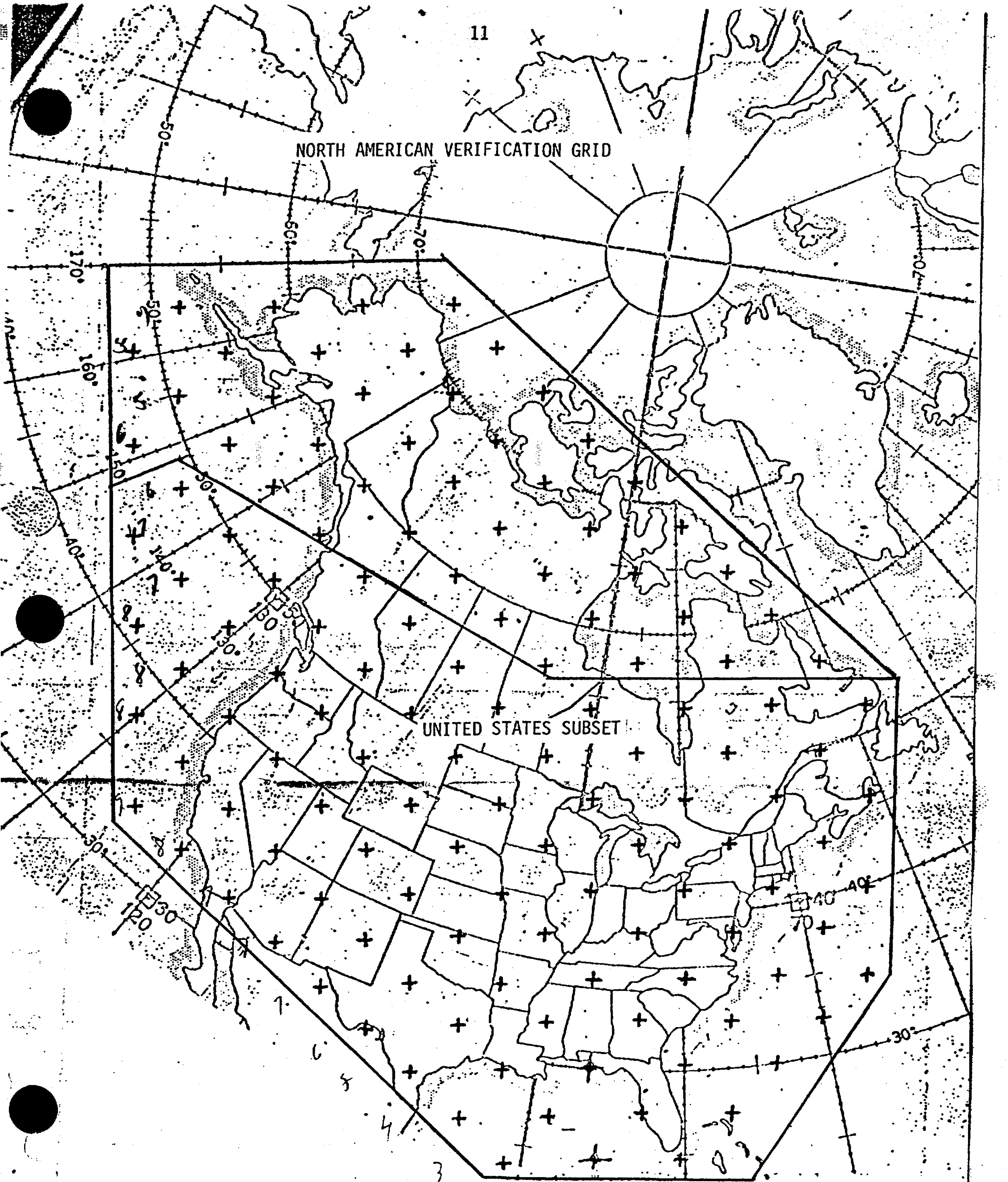

Fig 1

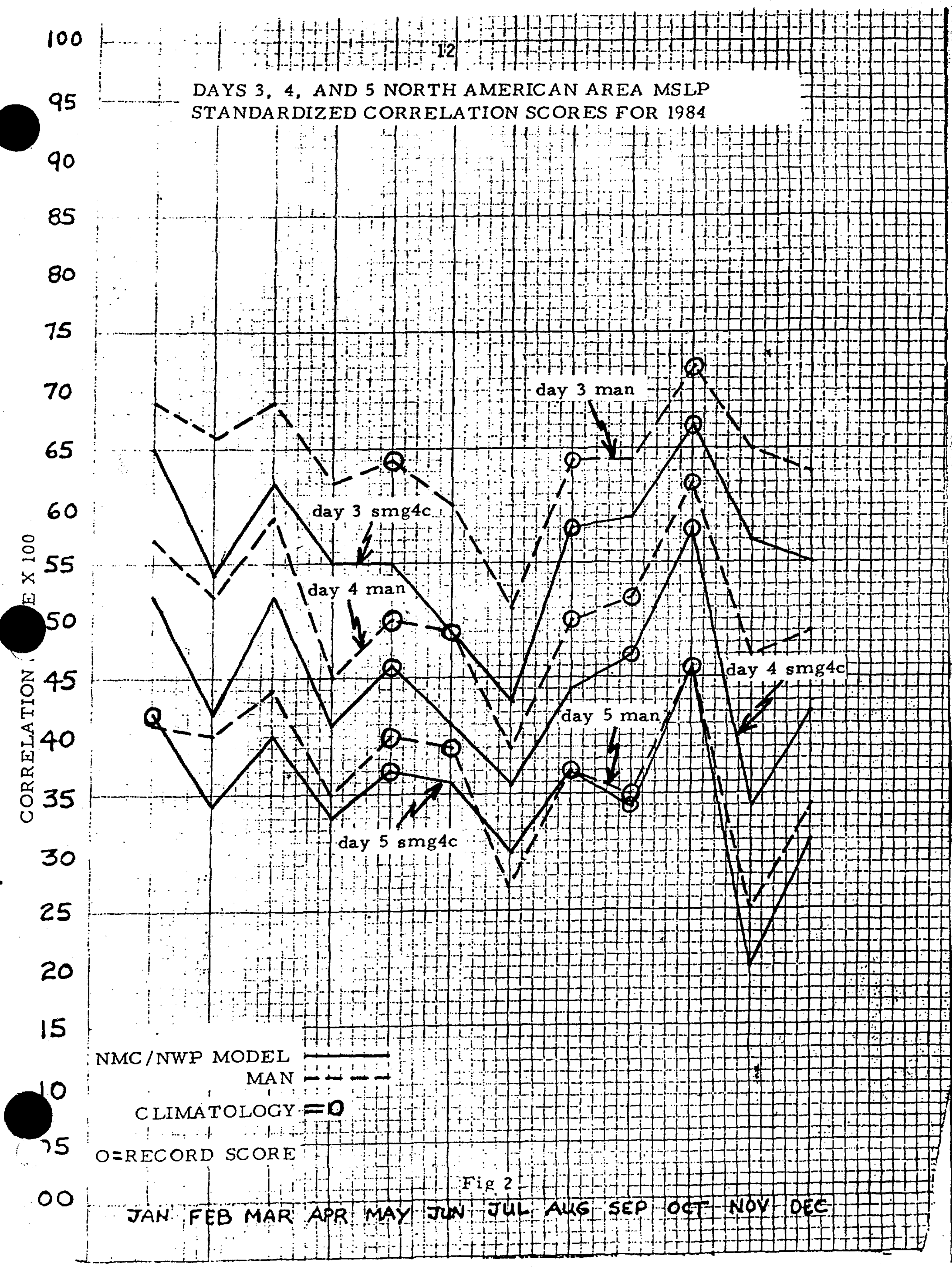
DAYS 3, 4, AND 5 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR 1984
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
O=RECORD SCORE
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
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Fig 2

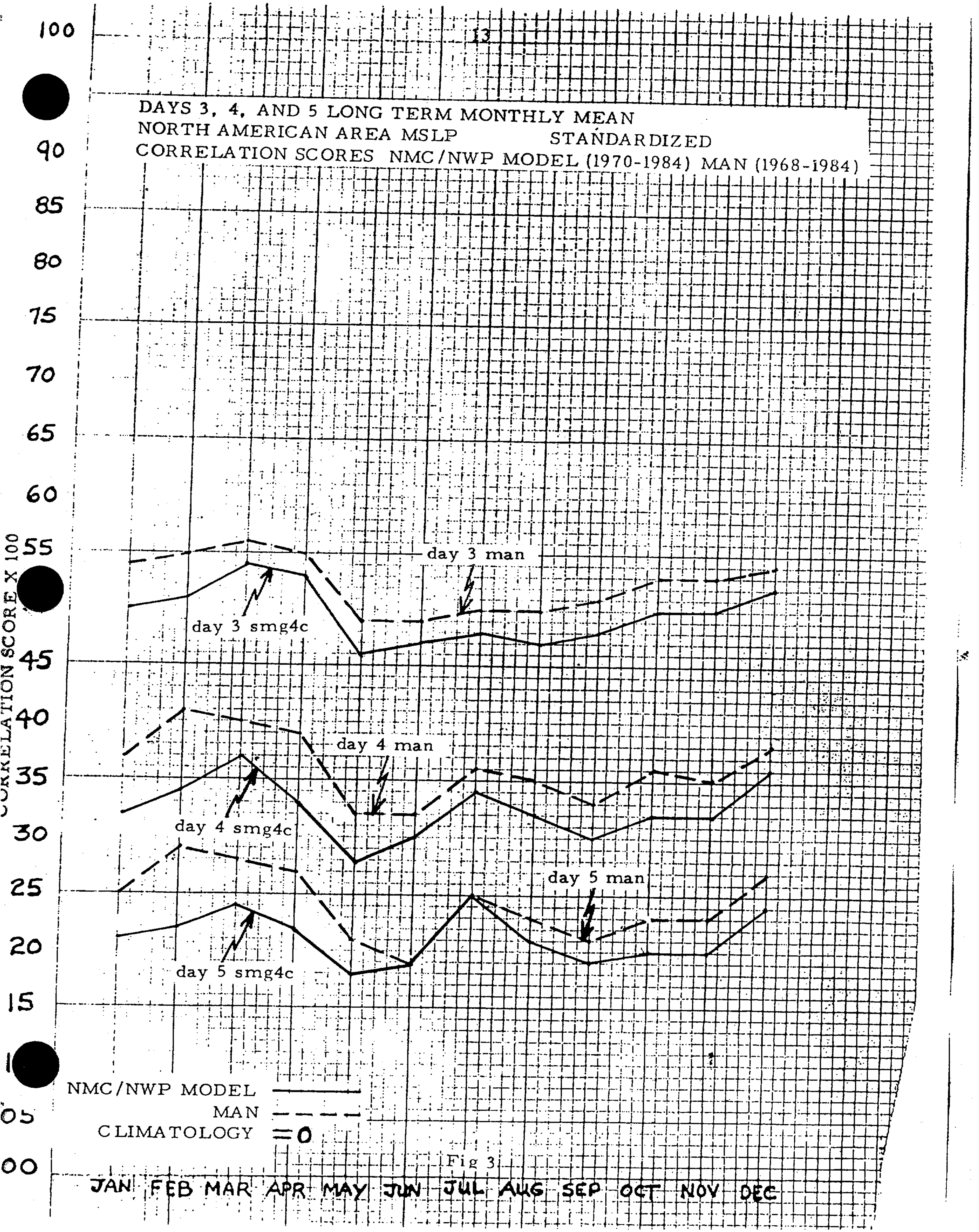
DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN
NORTH AMERICAN AREA MSLP STANDARDIZED
CORRELATION SCORES NMC/NWP MODEL (1970-1984) MAN (1968-1984)
CORRELATION SCORE X 100
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
05
00
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY =0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 3

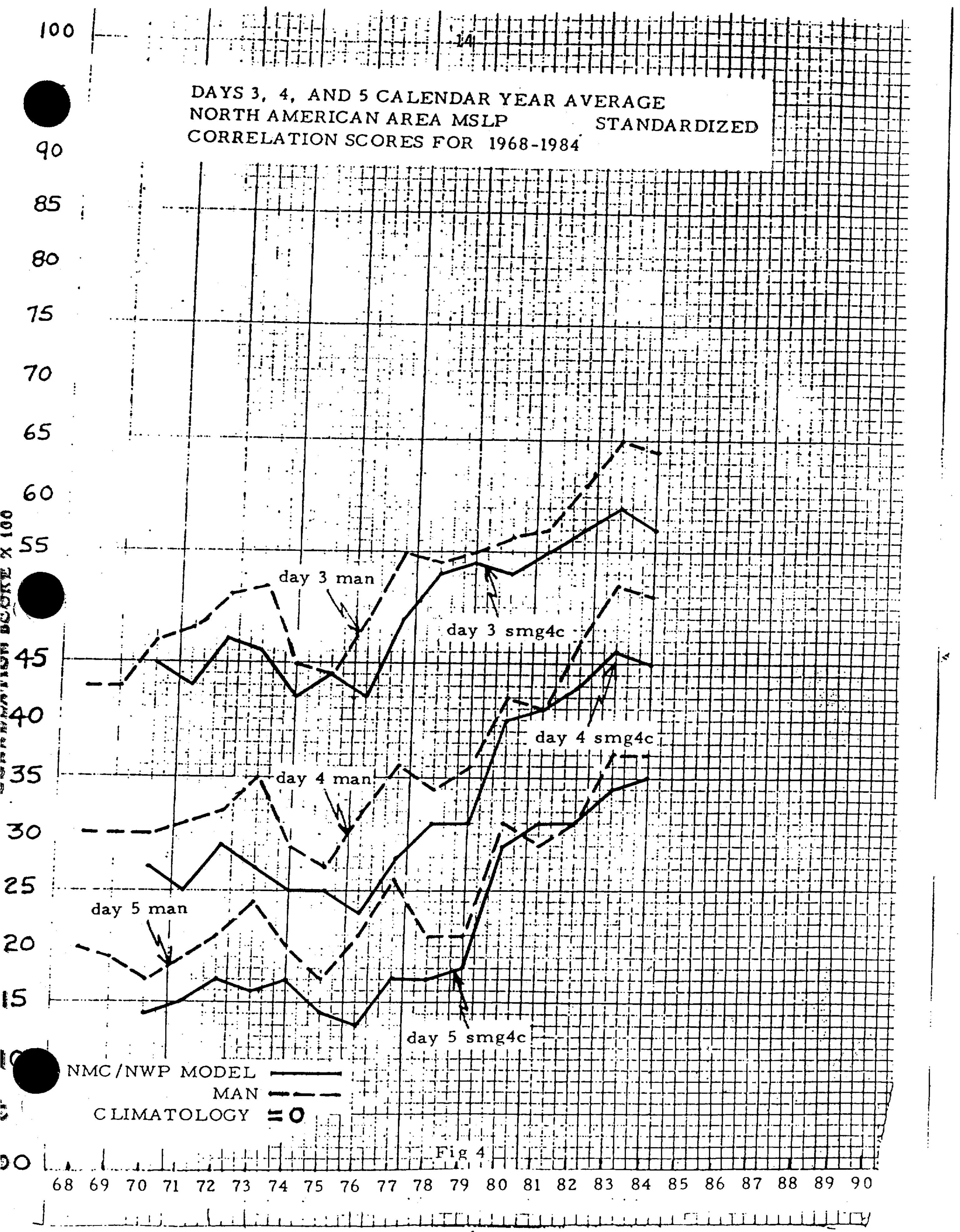
DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE
NORTH AMERICAN AREA MSLP
STANDARDIZED
CORRELATION SCORES FOR 1968-1984
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY ≡ 0
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

Fig 4

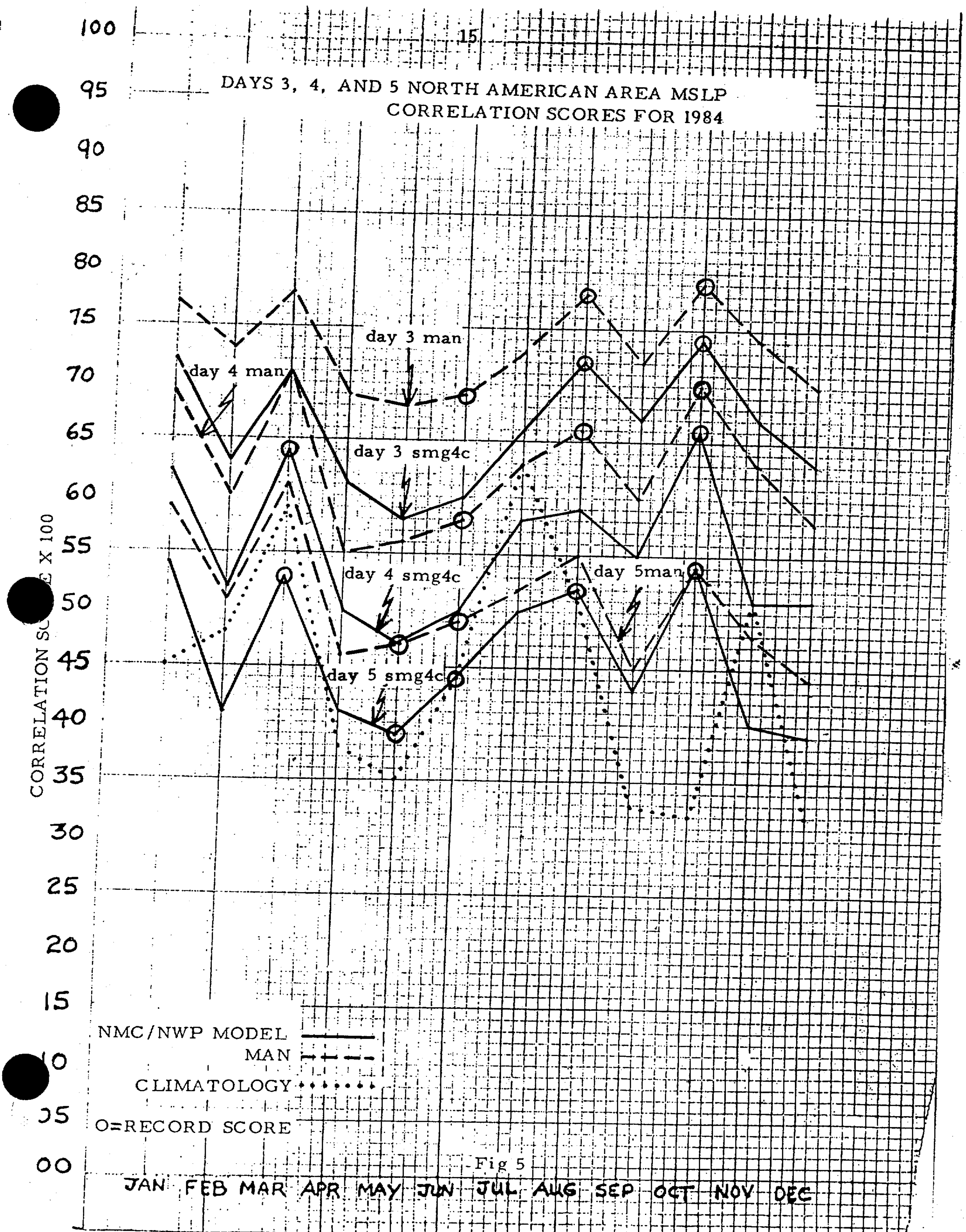
DAYS 3, 4, AND 5 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
day 3 man
day 4 man
day 3 smg4c
day 4 smg4c
day 5 smg4c
day 5man
NMC/NWP MODEL
MAN
CLIMATOLOGY
O=RECORD SCORE
JAN
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Fig 5

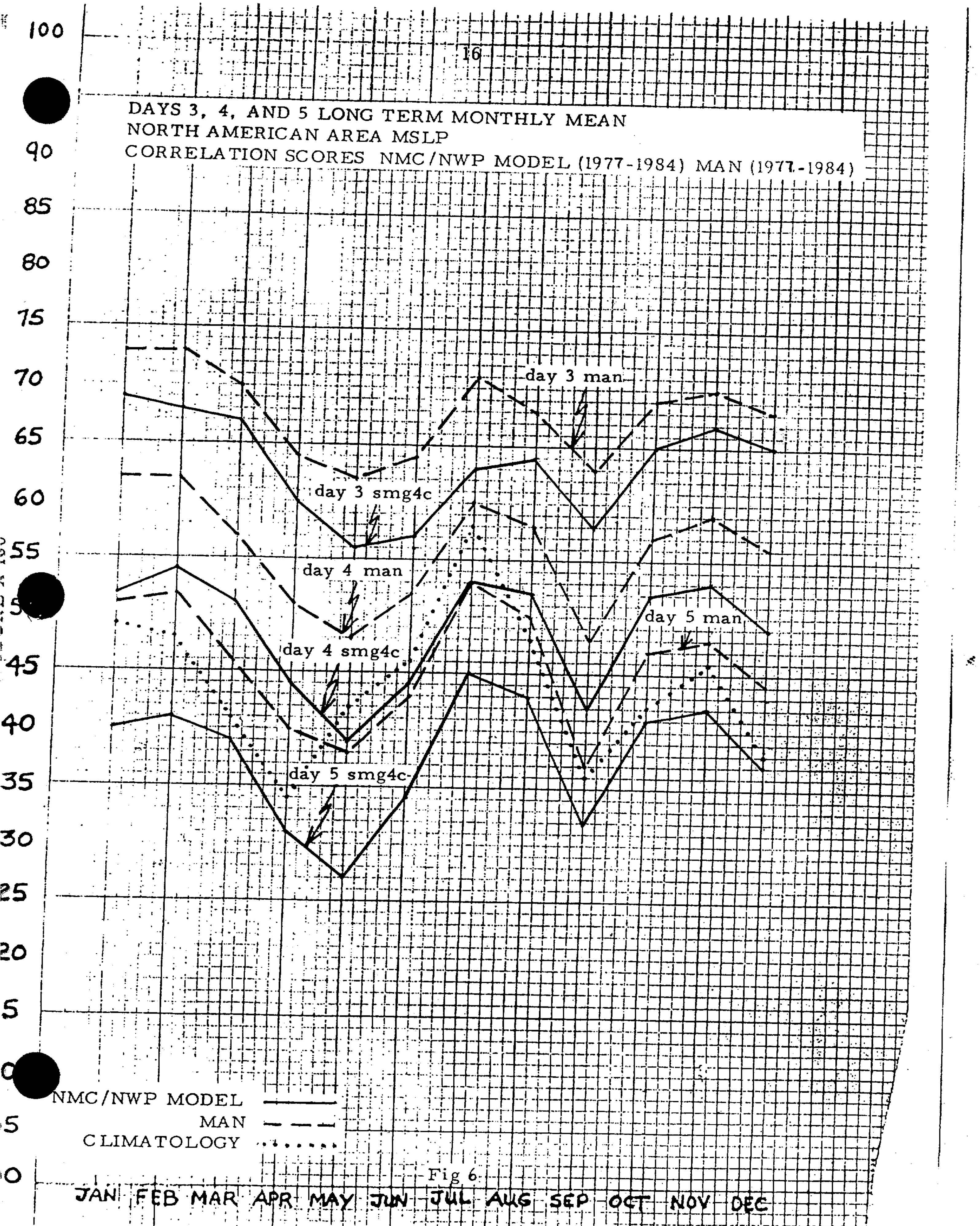
DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN
NORTH AMERICAN AREA MSLP
CORRELATION SCORES NMC/NWP MODEL (1977-1984) MAN (1977-1984)
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
5
5
0
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
JAN
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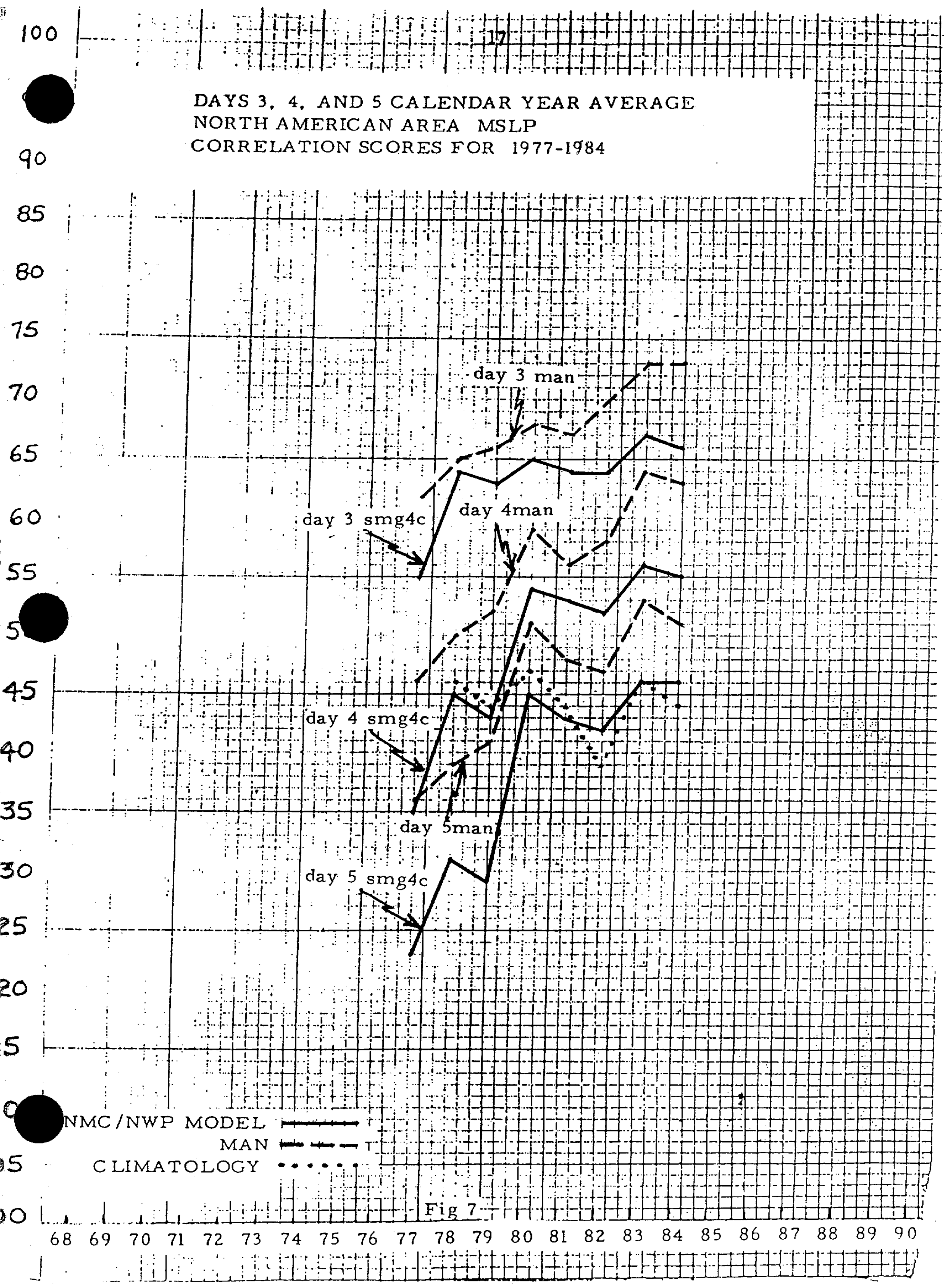
Fig 6



DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE
NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR 1977-1984
day 3 man
day 3 smg4c
day 4man
day 4 smg4c
day 5man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
Fig 7

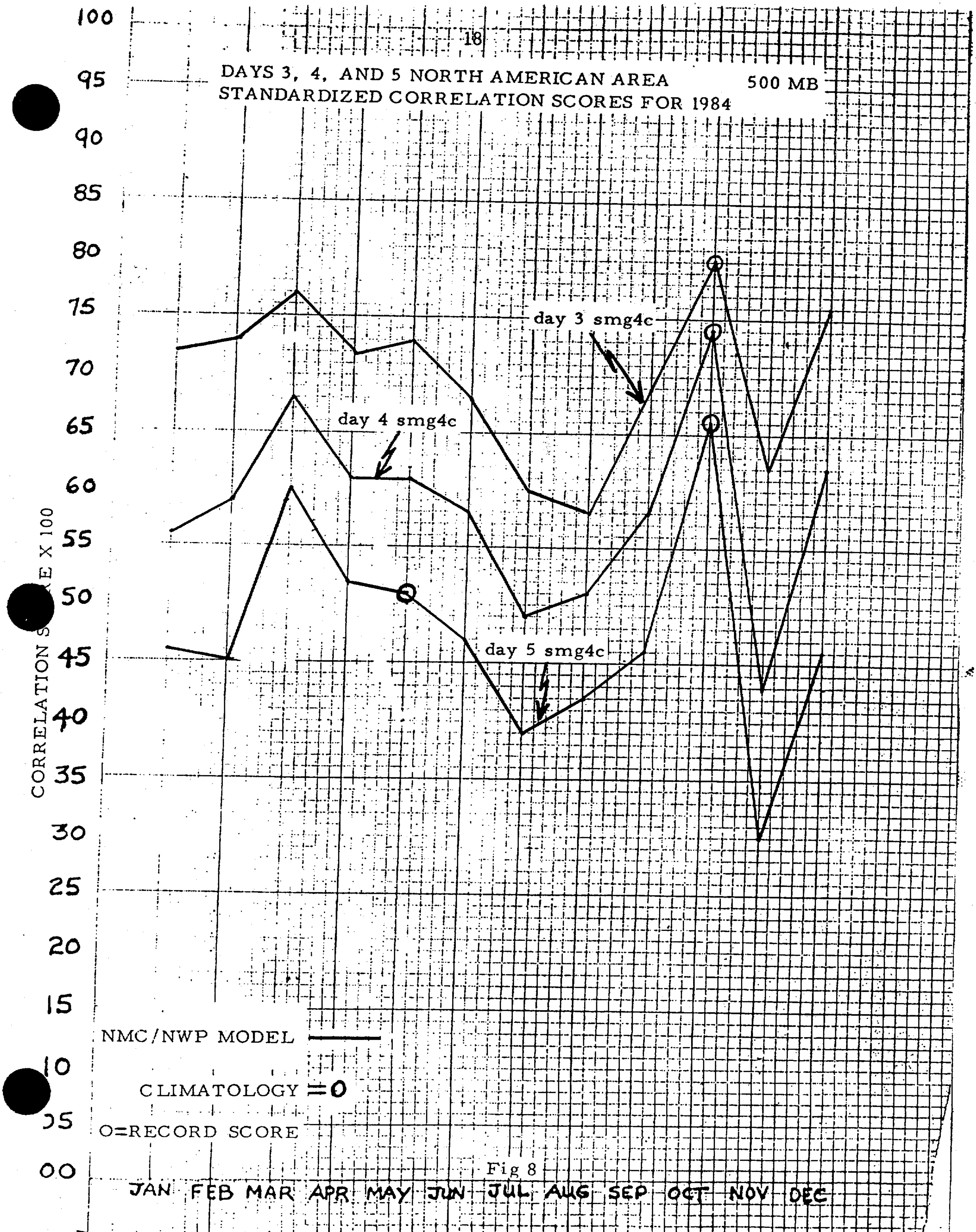

DAYS 3, 4, AND 5 NORTH AMERICAN AREA
STANDARDIZED CORRELATION SCORES FOR 1984
500 MB
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
day 3 smg4c
day 4 smg4c
day 5 smg4c
NMC/NWP MODEL
CLIMATOLOGY =0
O=RECORD SCORE
JAN
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Fig 8

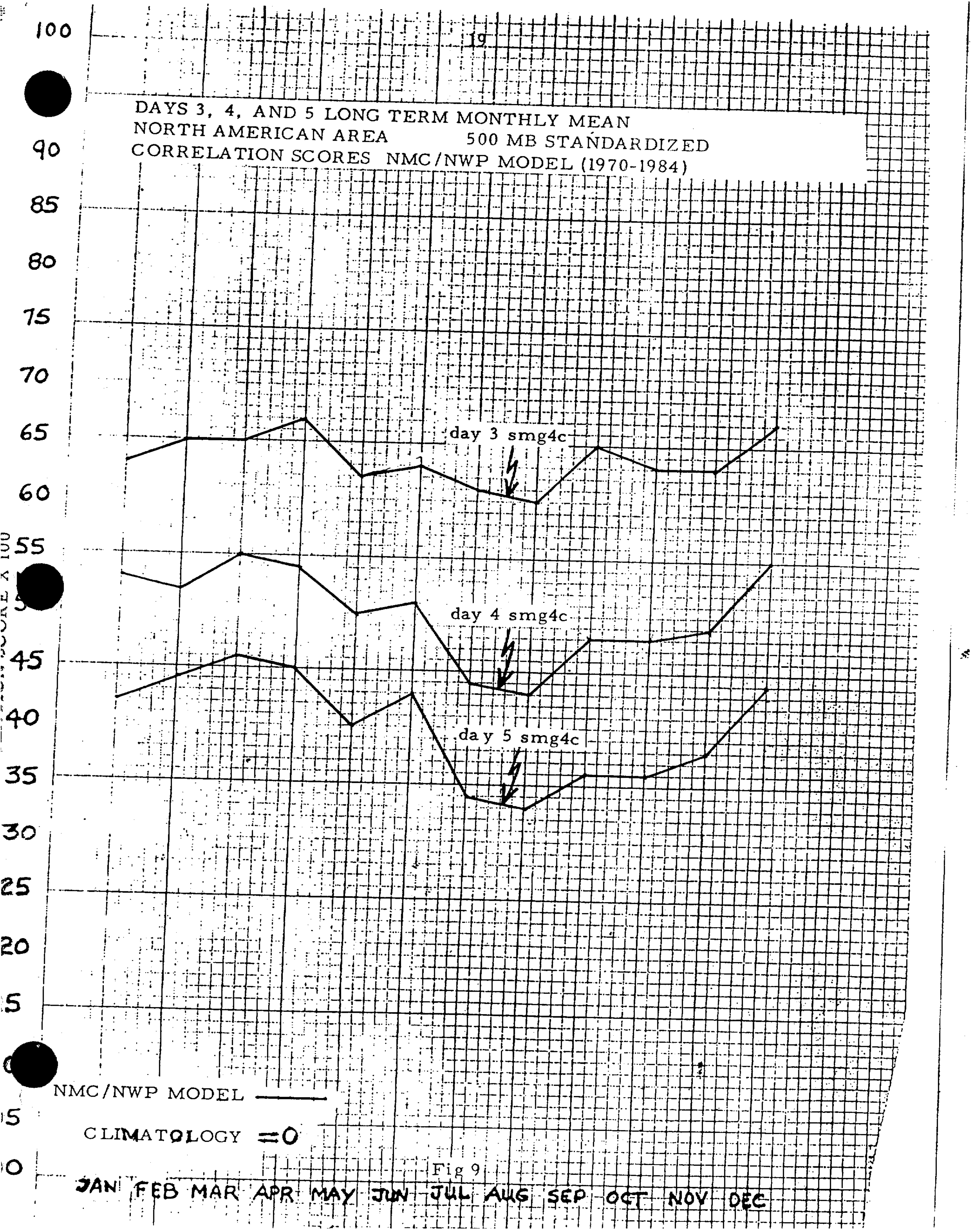
DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN
NORTH AMERICAN AREA
500 MB STANDARDIZED
CORRELATION SCORES NMC/NWP MODEL (1970-1984)
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
day 3 smg4c
day 4 smg4c
day 5 smg4c
NMC/NWP MODEL
CLIMATOLOGY =0
JAN
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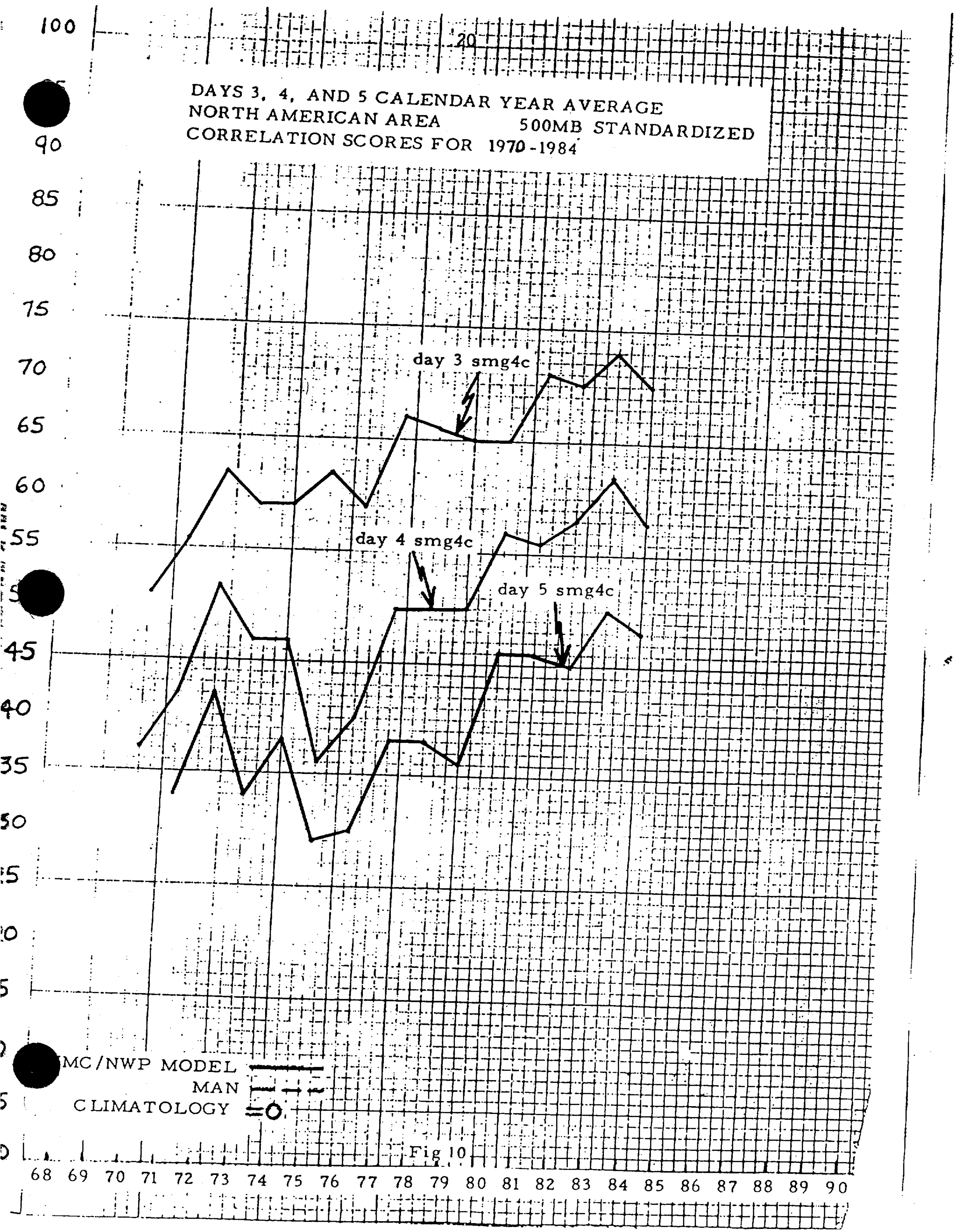
Fig 9



20
DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE
NORTH AMERICAN AREA 500MB STANDARDIZED
CORRELATION SCORES FOR 1970-1984
day 3 smg4c
day 4 smg4c
day 5 smg4c
MC/NWP MODEL
MAN
CLIMATOLOGY
100
90
85
80
75
70
65
60
55
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35
68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

Fig 10

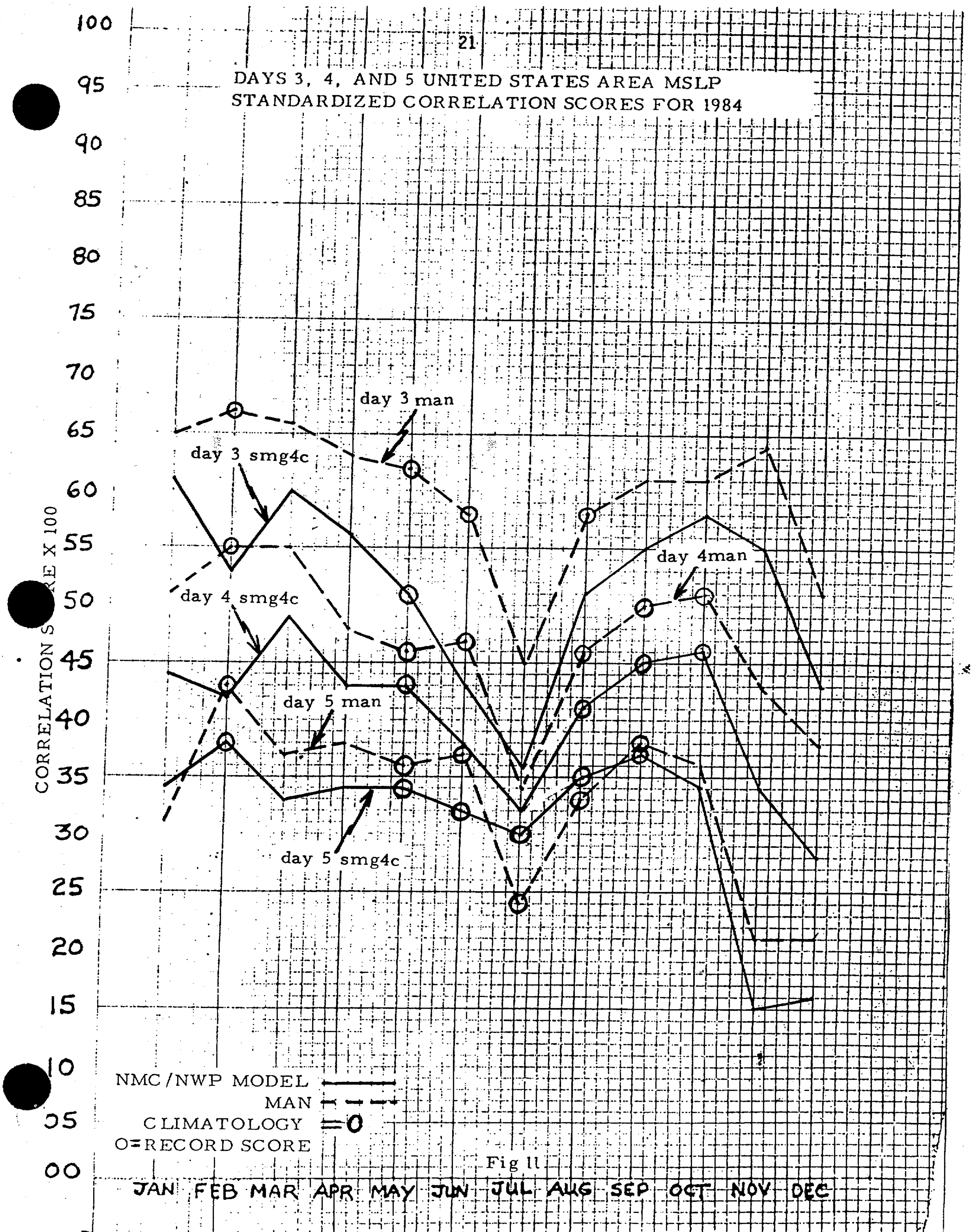
DAYS 3, 4, AND 5 UNITED STATES AREA MSLP
STANDARDIZED CORRELATION SCORES FOR 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
day 3 man
day 3 smg4c
day 4man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
O=RECORD SCORE
JAN
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Fig 11

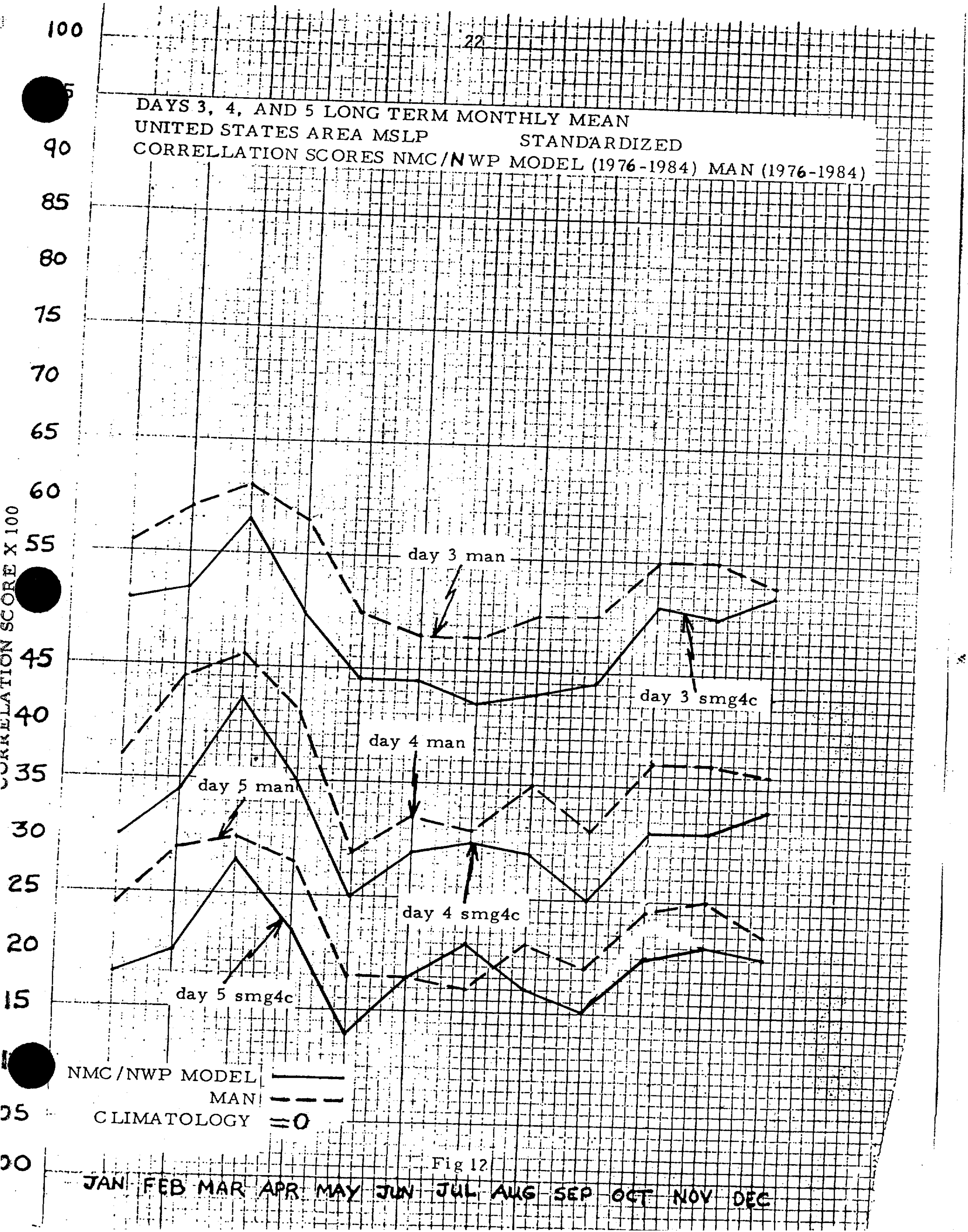
DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN
UNITED STATES AREA MSLP
STANDARDIZED
CORRELLATION SCORES NMC/NWP MODEL (1976-1984) MAN (1976-1984)
CORRELATION SCORE X 100
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY =0
JAN
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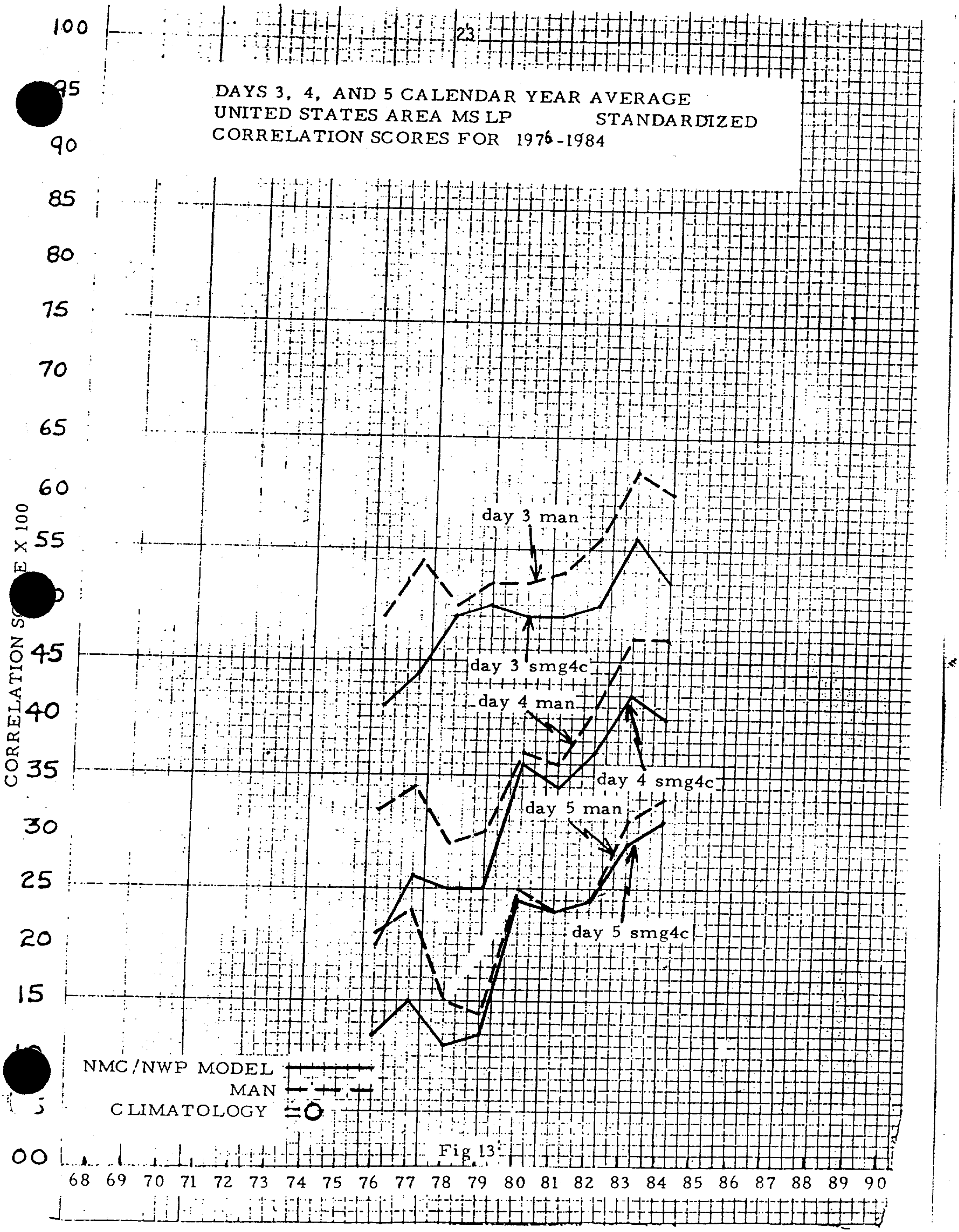
Fig 12


DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE
UNITED STATES AREA MS LP STANDARDIZED
CORRELATION SCORES FOR 1976-1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
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35
30
25
20
15
10
5
00
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

Fig 13

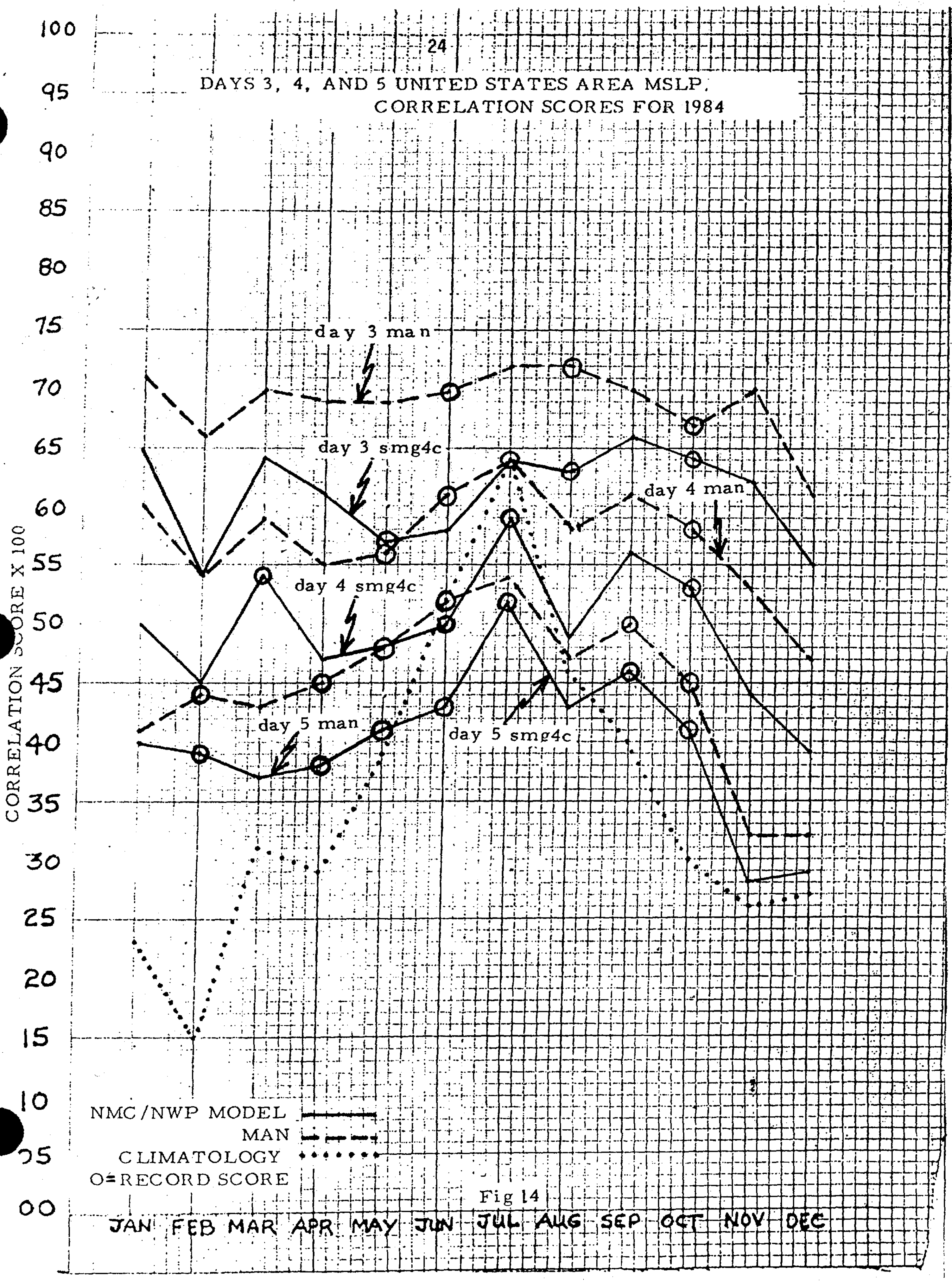
DAYS 3, 4, AND 5 UNITED STATES AREA MSLP.
CORRELATION SCORES FOR 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
O=RECORD SCORE
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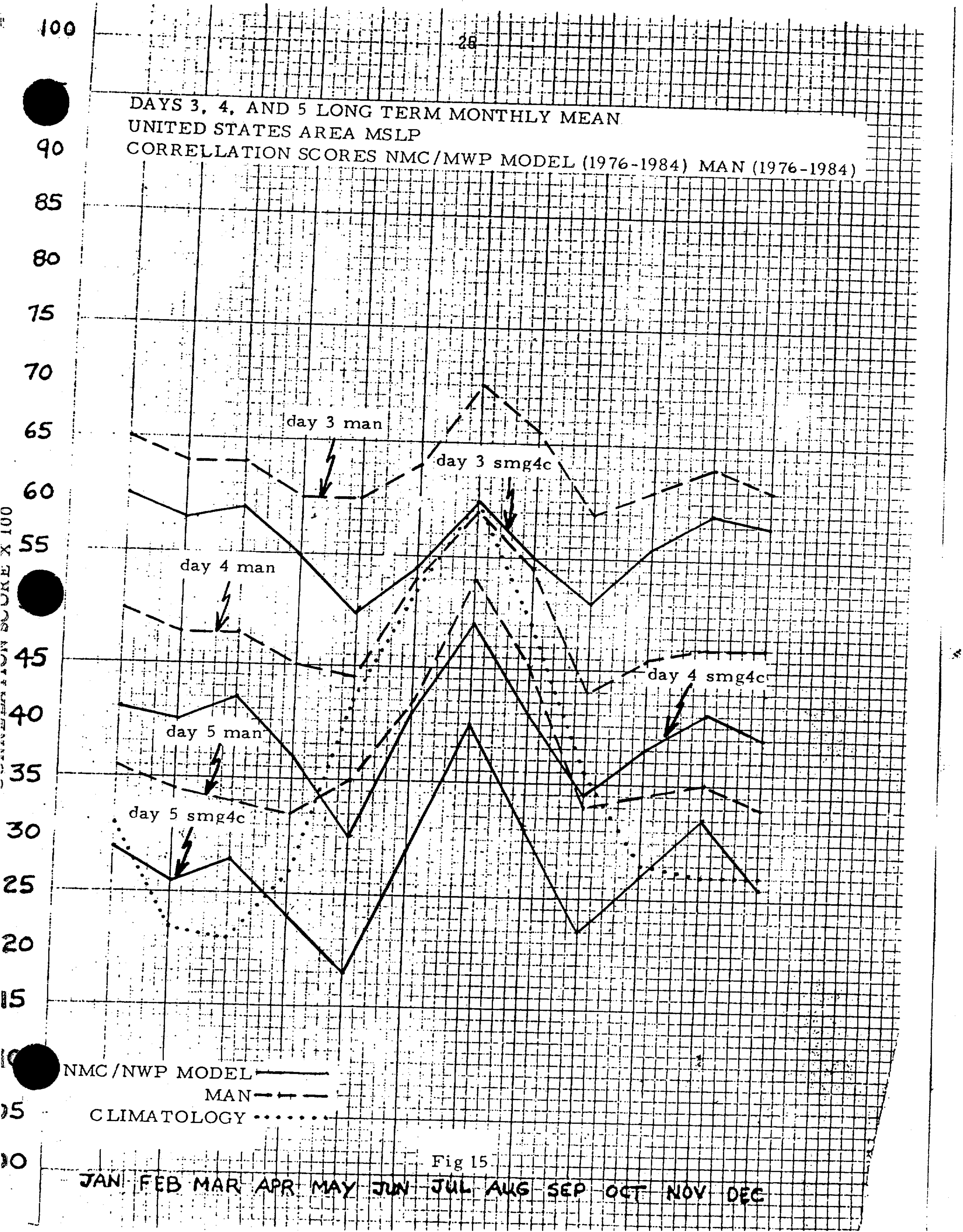
Fig 14


DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN
UNITED STATES AREA MSLP
CORRELLATION SCORES NMC/MWP MODEL (1976-1984) MAN (1976-1984)
day 3 man
day 3 smg4c
day 4 man
day 4 smg4c
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
100
90
85
80
75
70
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60
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Fig 15

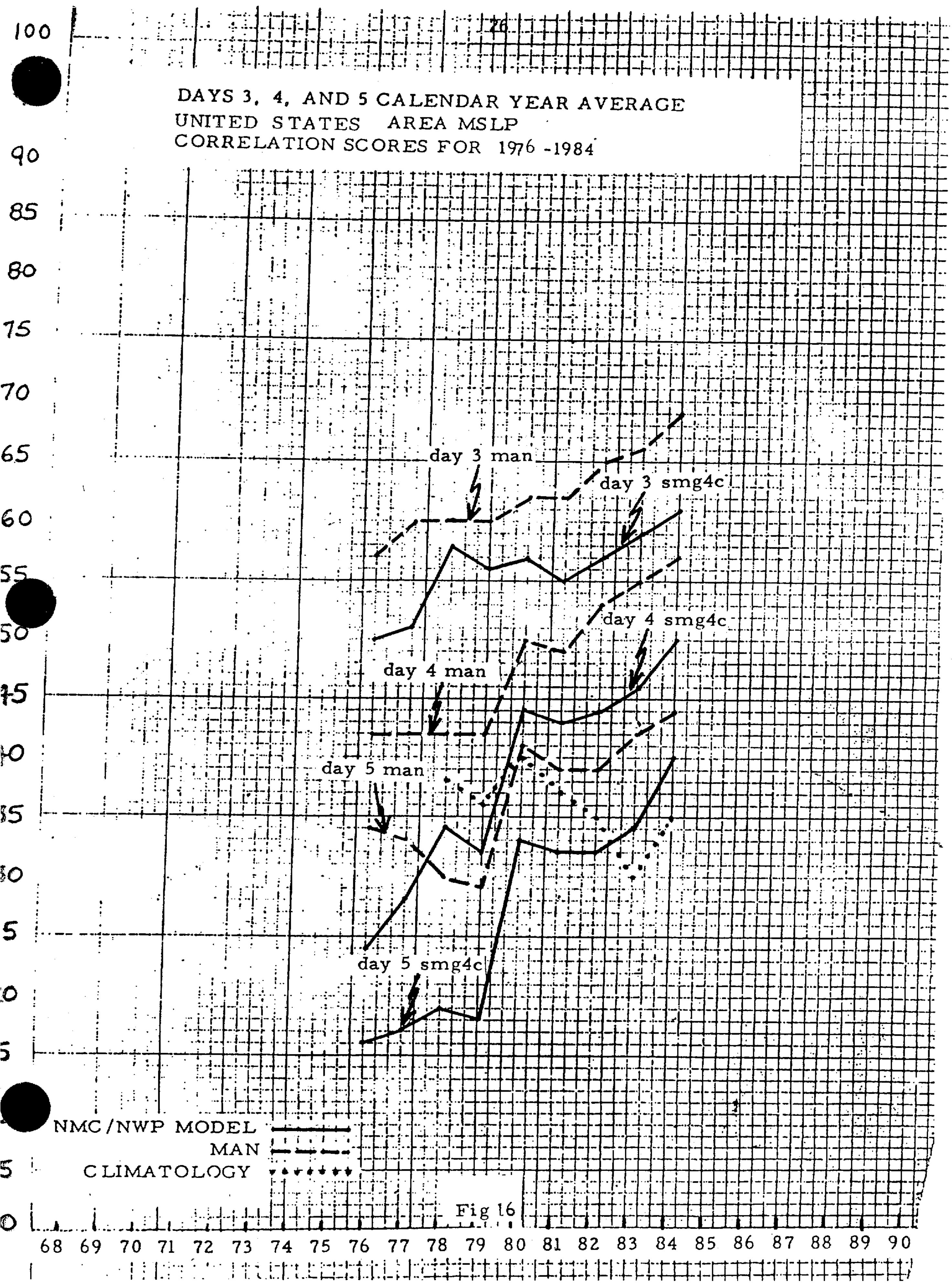

DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE
UNITED STATES AREA MSLP
CORRELATION SCORES FOR 1976 -1984
day 3 man
day 3 smg4c
day 4 smg4c
day 4 man
day 5 man
day 5 smg4c
NMC/NWP MODEL
MAN
CLIMATOLOGY
100
90
85
80
75
70
65
60
68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

Fig 16

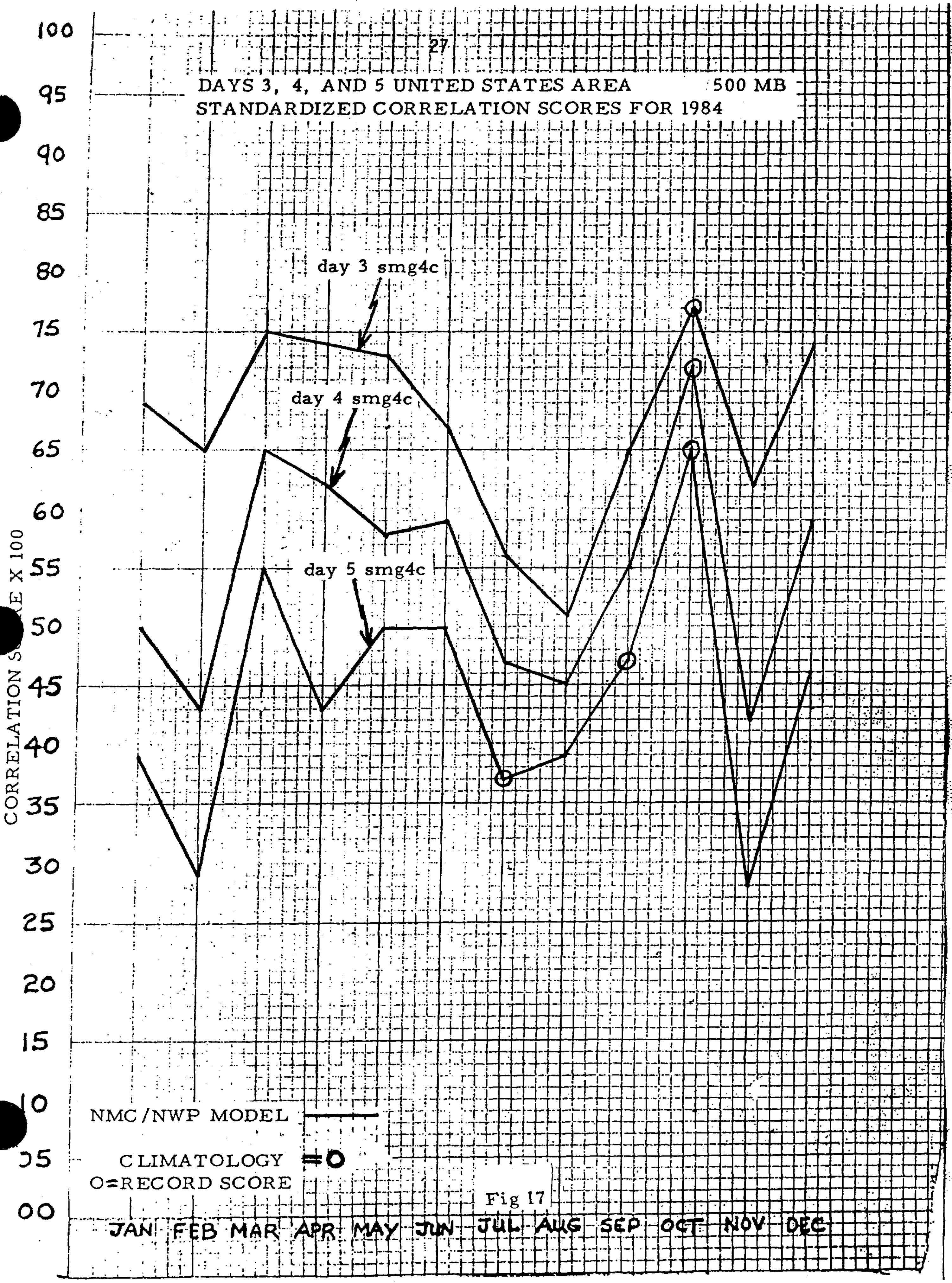

DAYS 3, 4, AND 5 UNITED STATES AREA 500 MB
STANDARDIZED CORRELATION SCORES FOR 1984
day 3 smg4c
day 4 smg4c
day 5 smg4c
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
NMC/NWP MODEL
CLIMATOLOGY =O
O=RECORD SCORE
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig 17

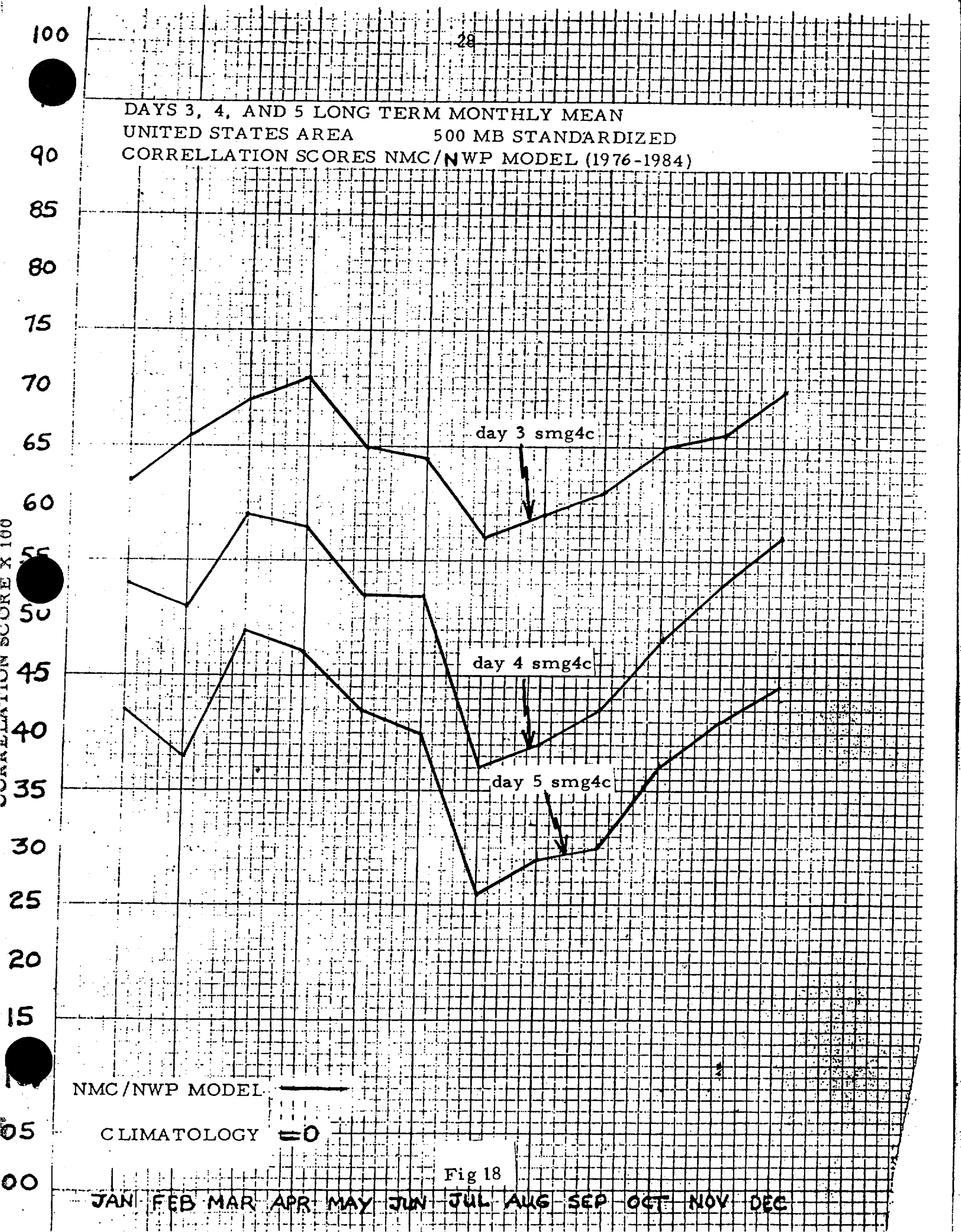
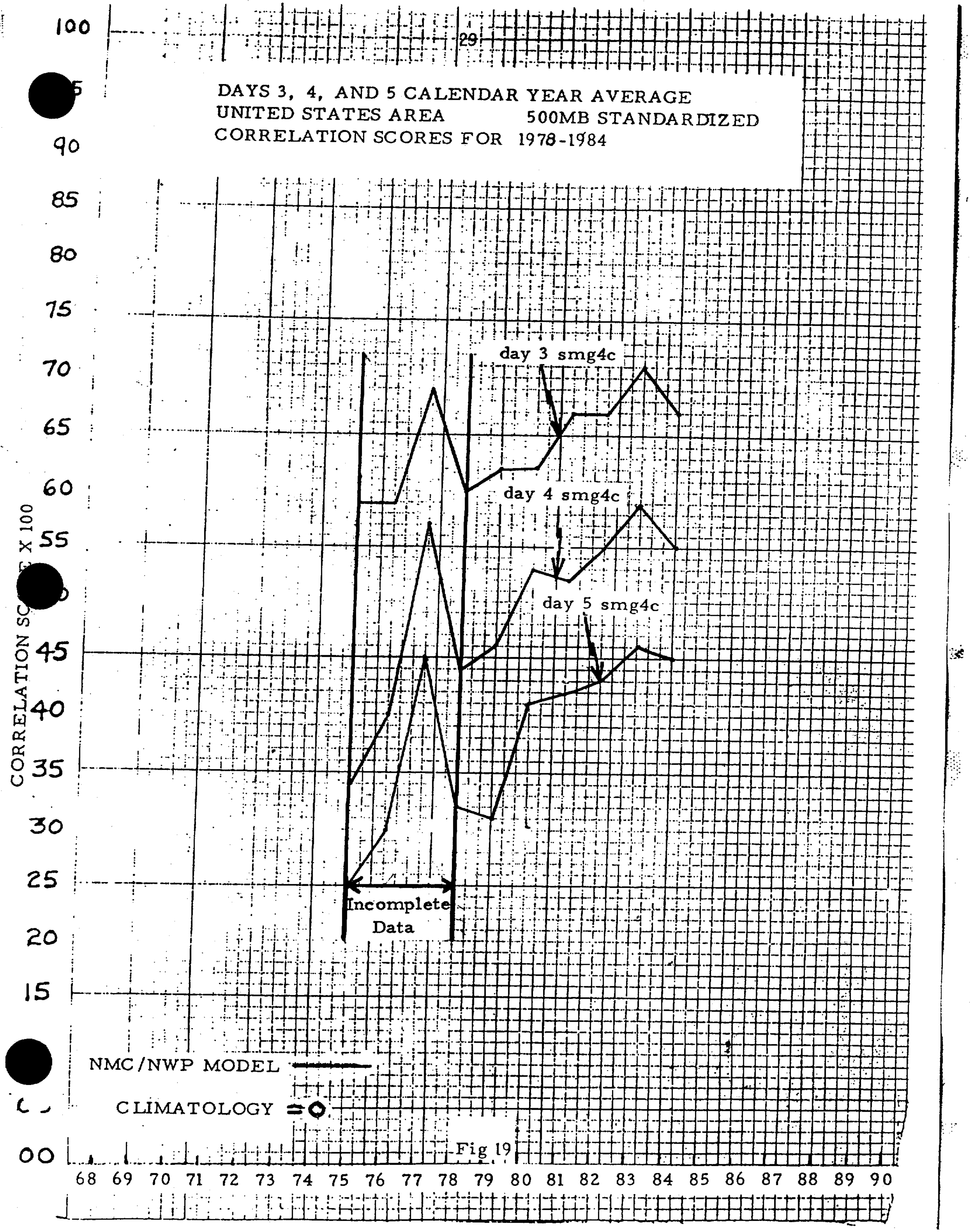
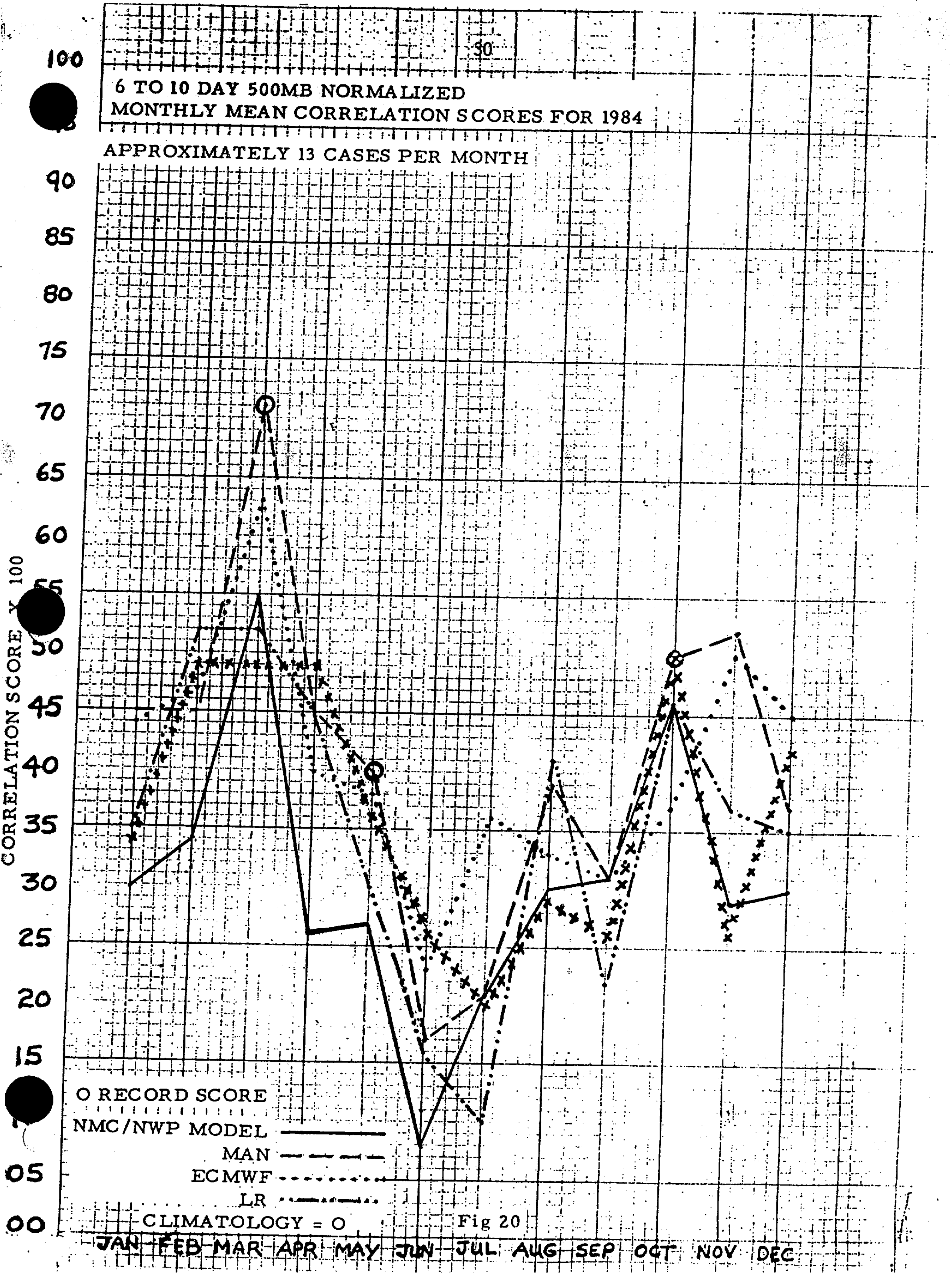

DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN
UNITED STATES AREA 500 MB STANDARDIZED
CORRELLATION SCORES NMC/NWP MODEL (1976-1984)
day 3 smg4c
day 4 smg4c
day 5 smg4c
NMC/NWP MODEL
CLIMATOLOGY =0
CORRELATION SCORE X 100
100
90
85
80
75
70
65
60
50
45
40
35
30
25
20
15
05
00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 18



DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE
UNITED STATES AREA
500MB STANDARDIZED
CORRELATION SCORES FOR 1978-1984
CORRELATION SC X 100
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
00
day 3 smg4c
day 4 smg4c
day 5 smg4c
Incomplete Data
NMC/NWP MODEL
CLIMATOLOGY =
68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

Fig 19



30
6 TO 10 DAY 500MB NORMALIZED
MONTHLY MEAN CORRELATION SCORES FOR 1984
APPROXIMATELY 13 CASES PER MONTH
CORRELATION SCORE X 100
100
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
05
00
O RECORD SCORE
NMC/NWP MODEL
MAN
ECMWF
LR
CLIMATOLOGY = O
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 20

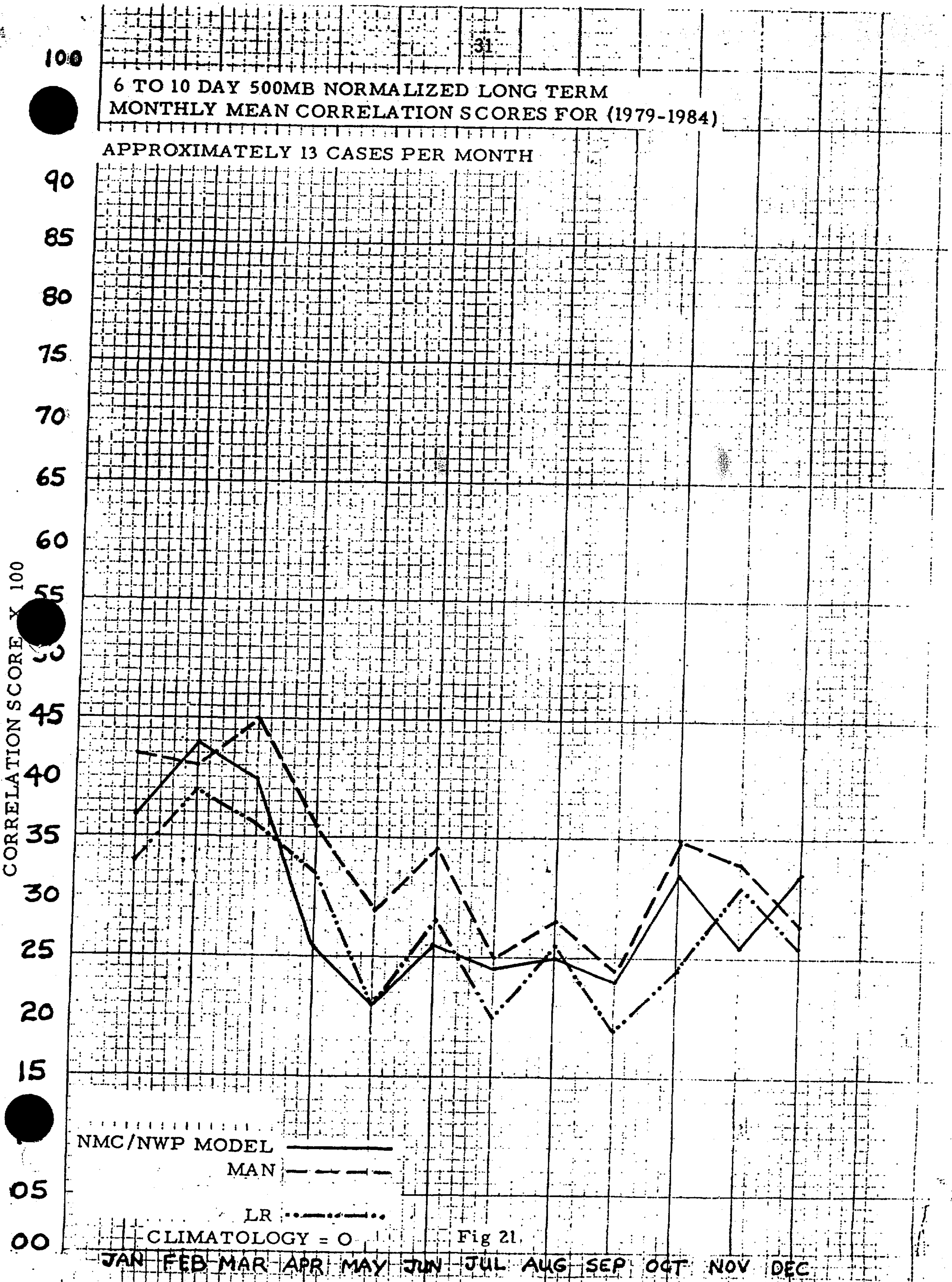

6 TO 10 DAY 500MB NORMALIZED LONG TERM
MONTHLY MEAN CORRELATION SCORES FOR (1979-1984)
APPROXIMATELY 13 CASES PER MONTH
CORRELATION SCORE X 100
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
05
00
NMC/NWP MODEL
MAN
LR
CLIMATOLOGY = O
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 21

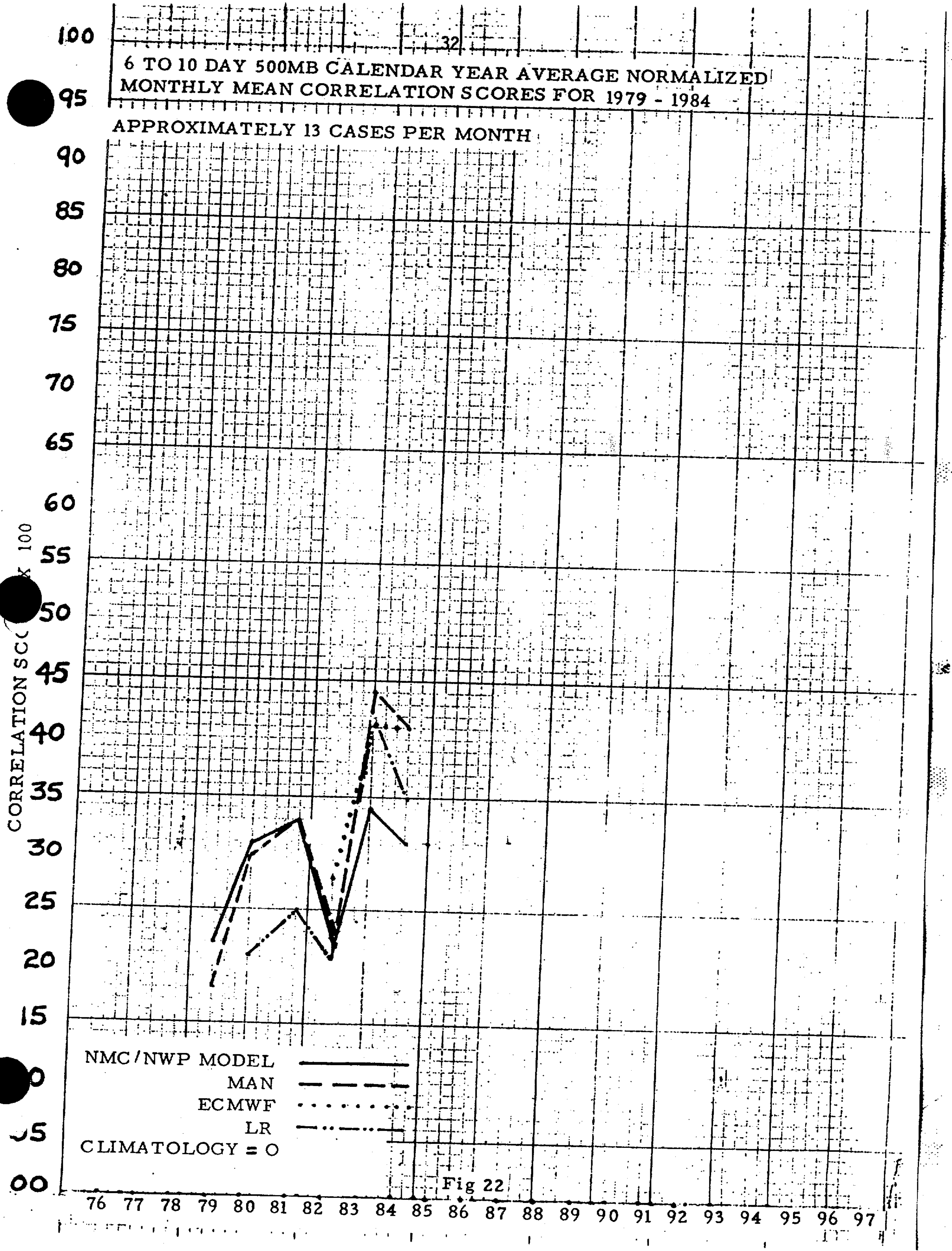
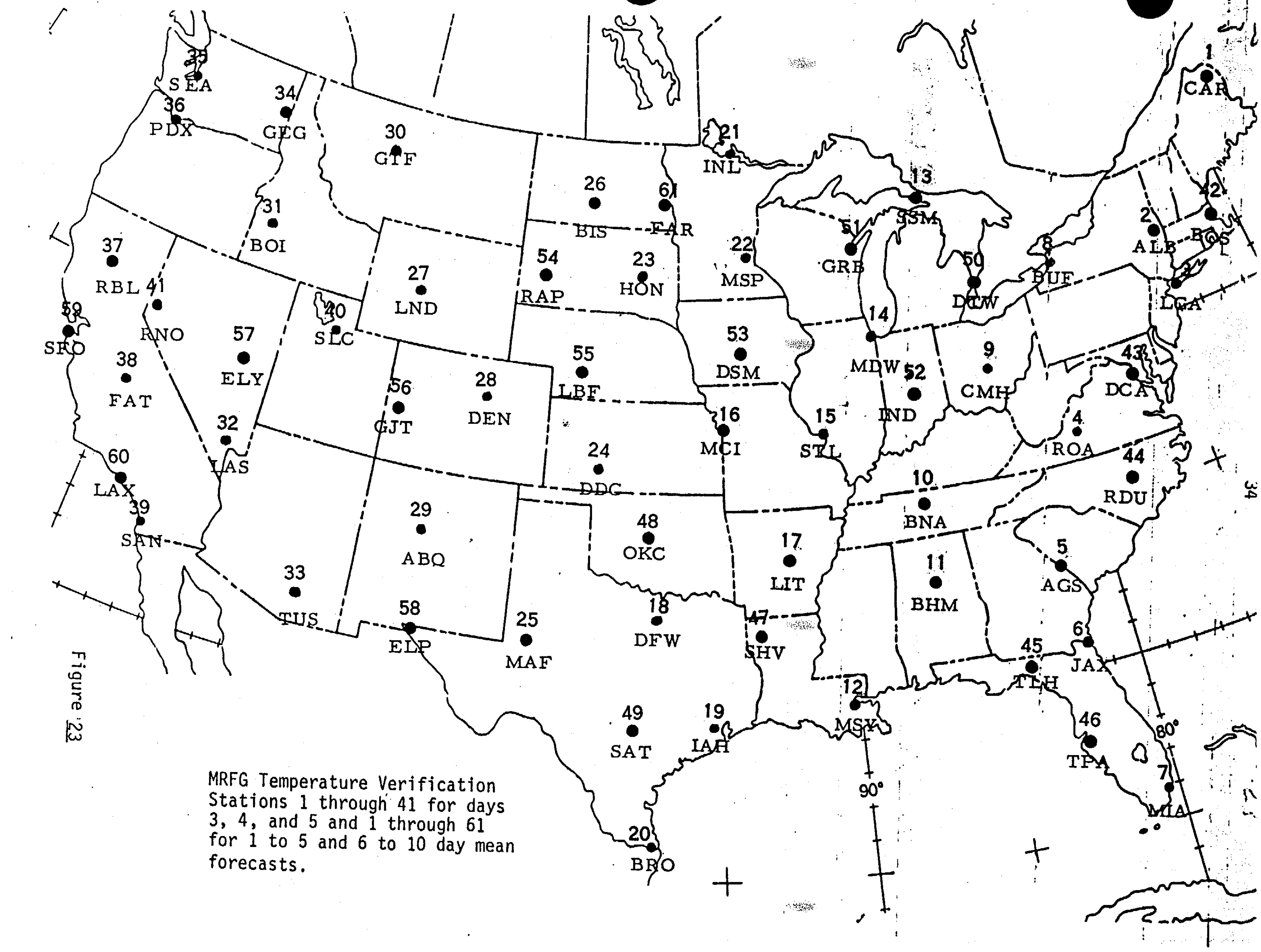

6 TO 10 DAY 500MB CALENDAR YEAR AVERAGE NORMALIZED
MONTHLY MEAN CORRELATION SCORES FOR 1979 - 1984
APPROXIMATELY 13 CASES PER MONTH
CORRELATION SCORES x 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
00
NMC/NWP MODEL
MAN
ECMWF
LR
CLIMATOLOGY = O
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97

Fig 22

SECTION 2

Man & Machine (KL Guidance)

Absolute Error Temperature Scores



MRFG Temperature Verification
Stations 1 through 41 for days
3, 4, and 5 and 1 through 61
for 1 to 5 and 6 to 10 day mean
forecasts.

Figure 23

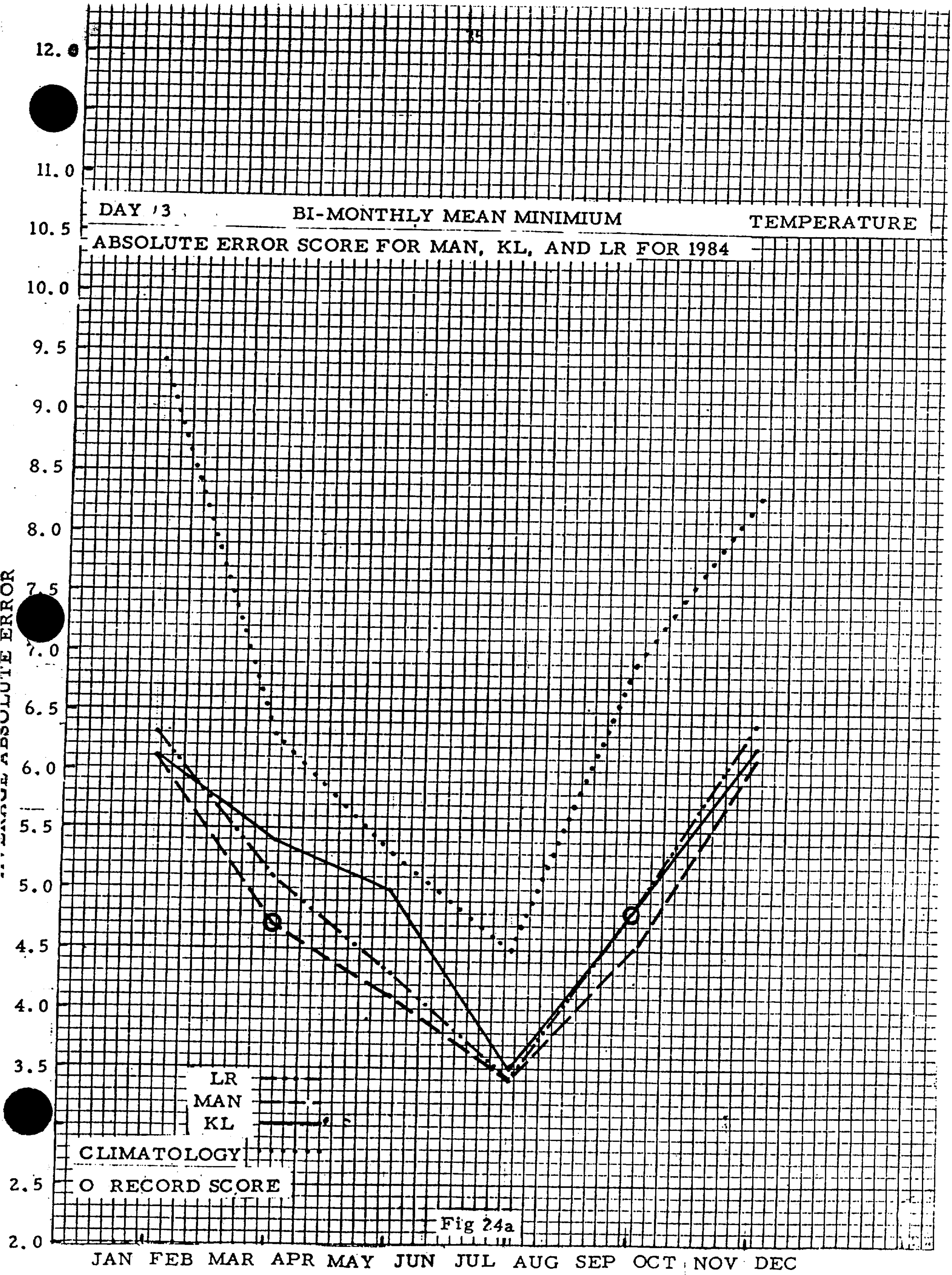
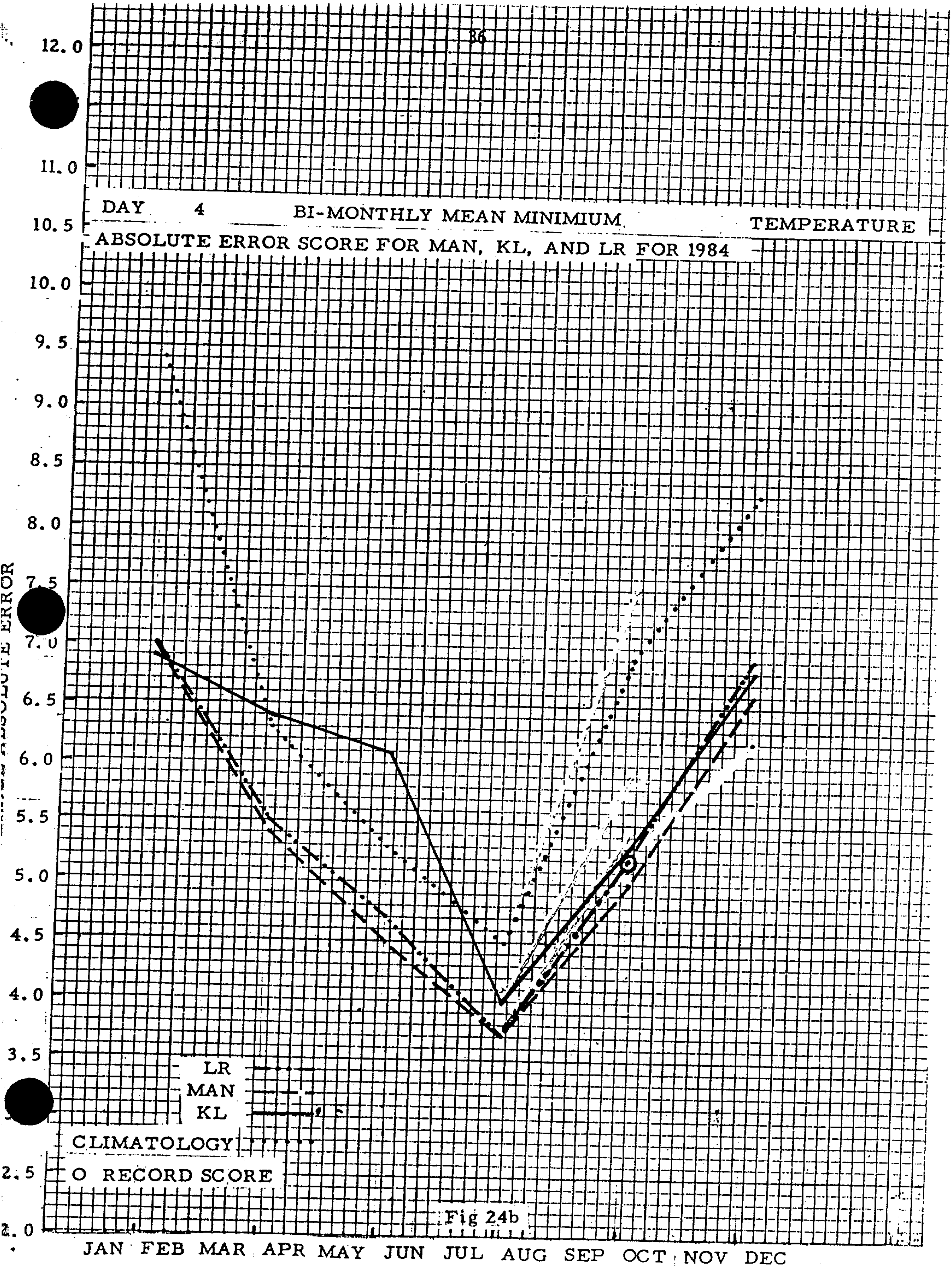

DAY 3
BI-MONTHLY MEAN MINIMIUM TEMPERATURE
ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR FOR 1984
ABSOLUTE ERROR
12.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
O RECORD SCORE
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 24a


DAY 4 BI-MONTHLY MEAN MINIMIUM TEMPERATURE
ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR FOR 1984
ABSOLUTE ERROR
12.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
O RECORD SCORE
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Fig 24b

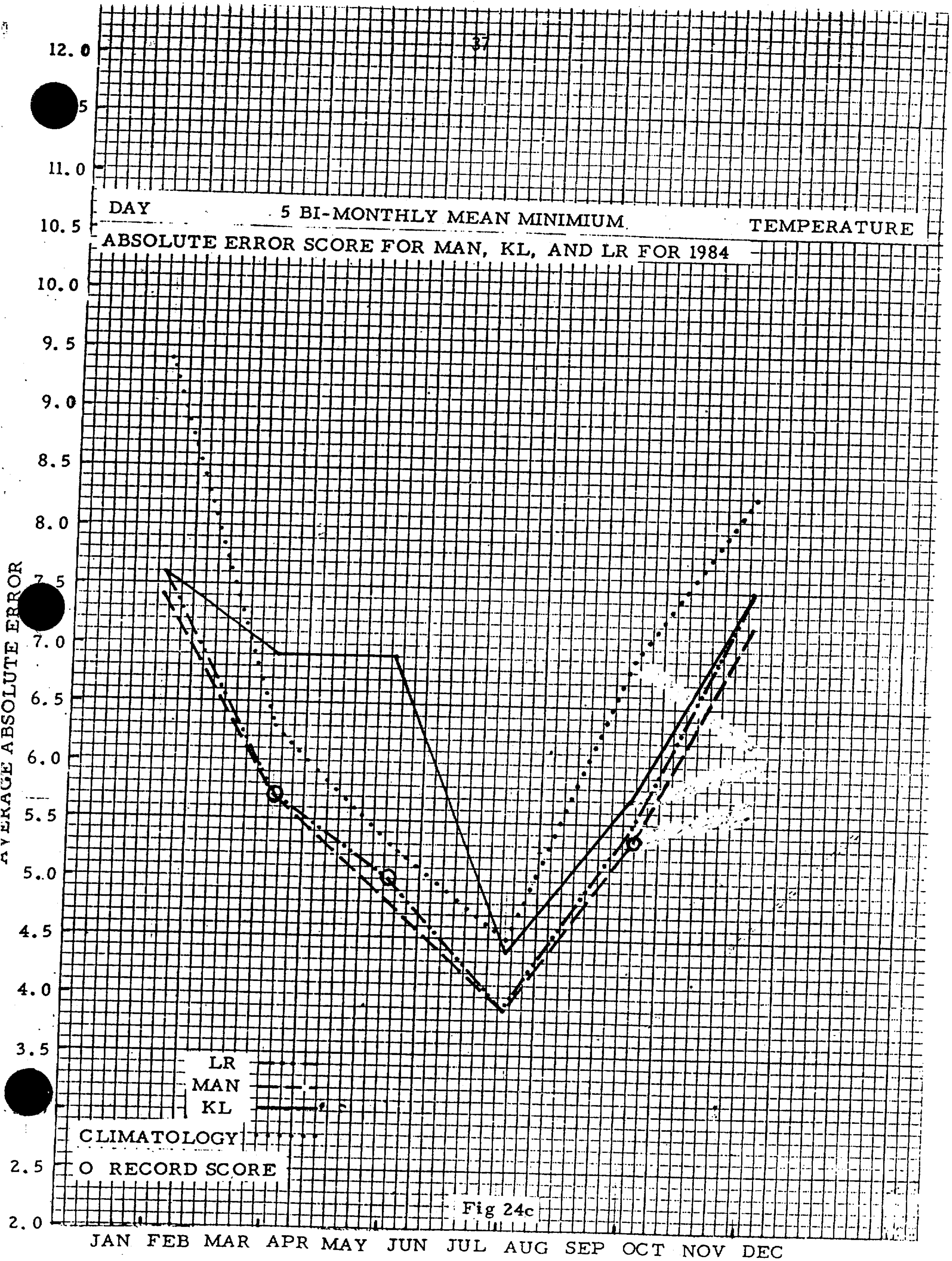

DAY 5 BI-MONTHLY MEAN MINIMUM TEMPERATURE
ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR FOR 1984
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2.5
2.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
LR
MAN
KL
CLIMATOLOGY
O RECORD SCORE

Fig 24c

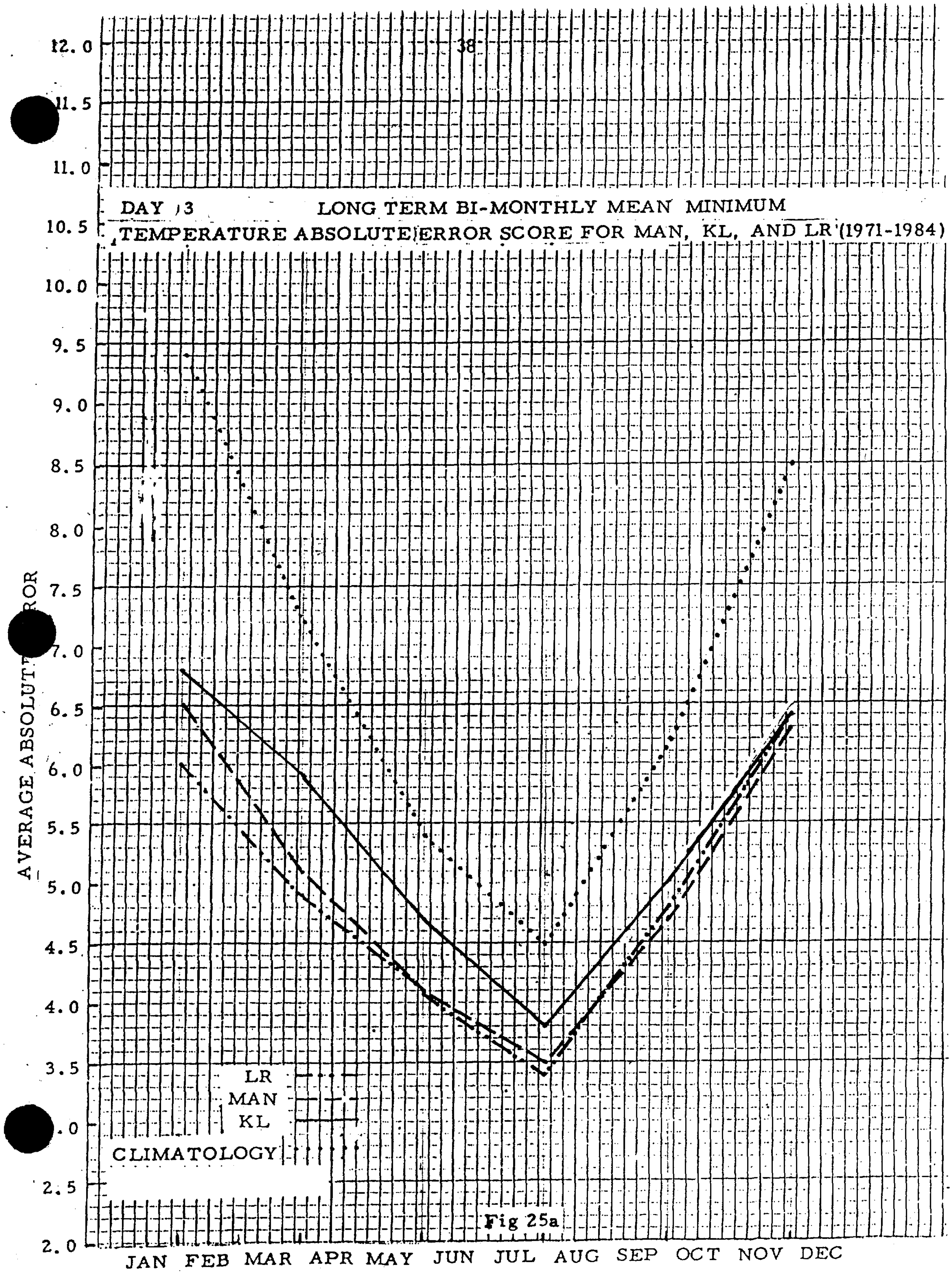
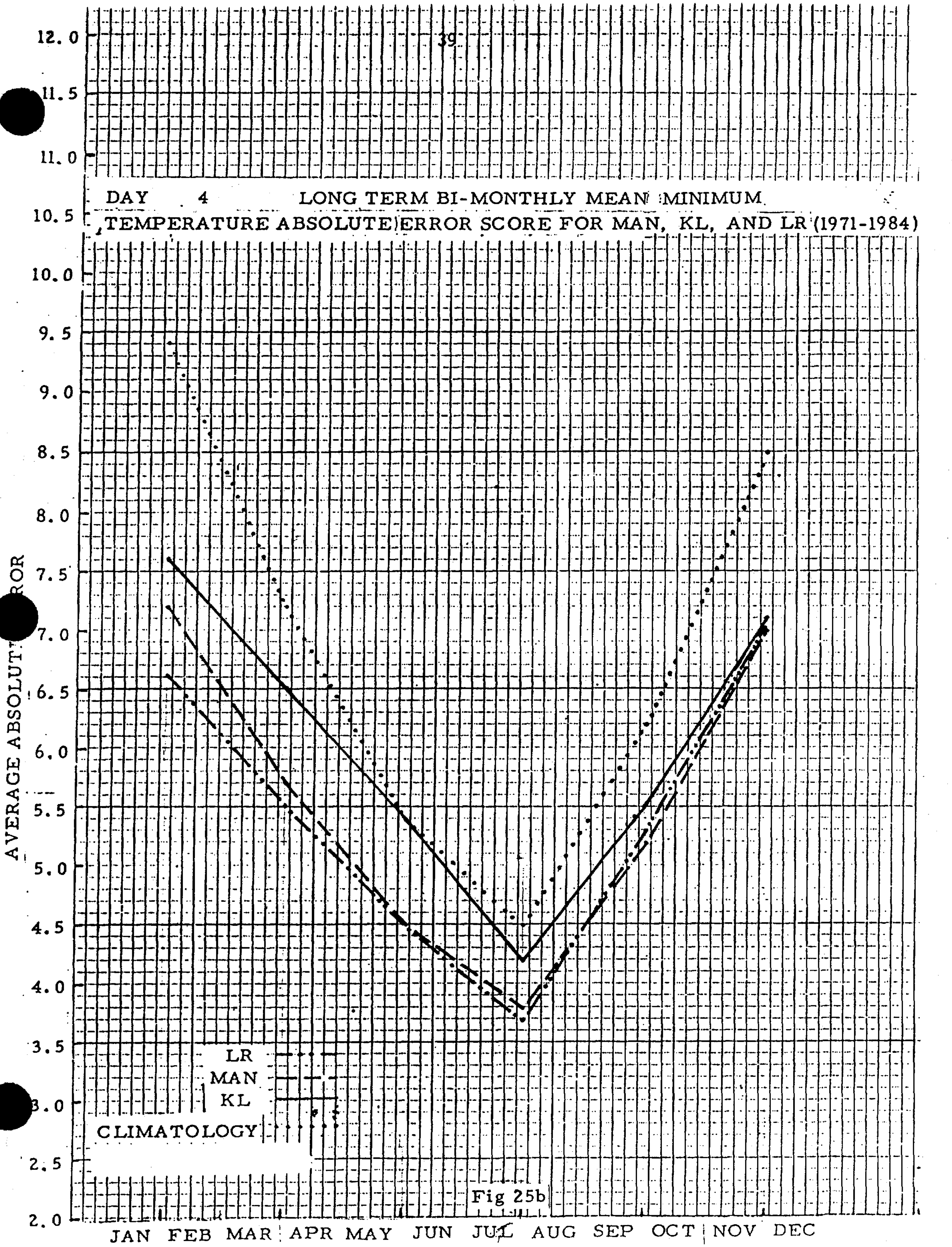
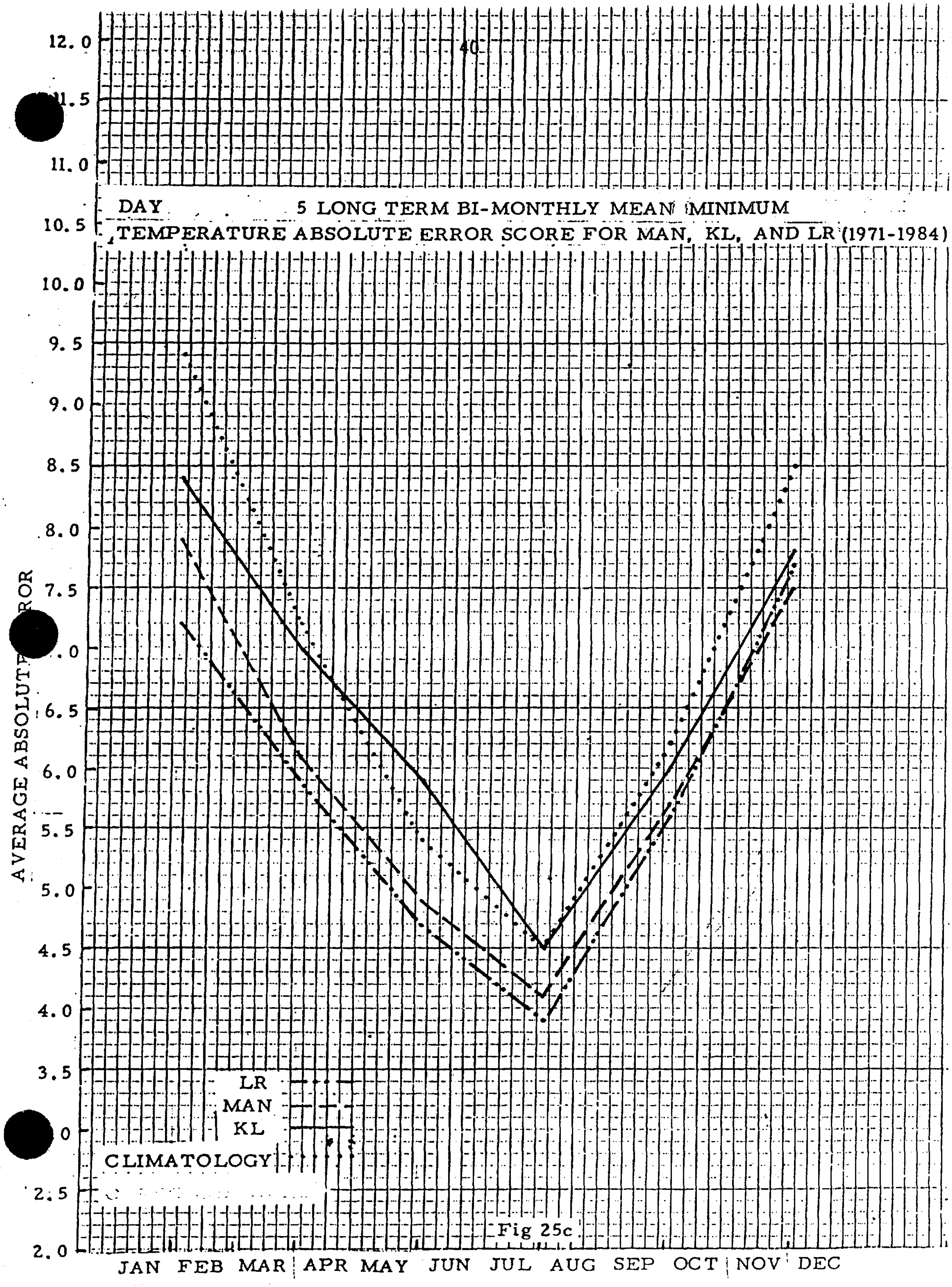

DAY 3 LONG TERM BI-MONTHLY MEAN MINIMUM
TEMPERATURE ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR (1971-1984)
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 25a



DAY 4 LONG TERM BI-MONTHLY MEAN MINIMUM
TEMPERATURE ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR (1971-1984)
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 25b


DAY 5 LONG TERM BI-MONTHLY MEAN MINIMUM TEMPERATURE ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR (1971-1984)
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Fig 25c

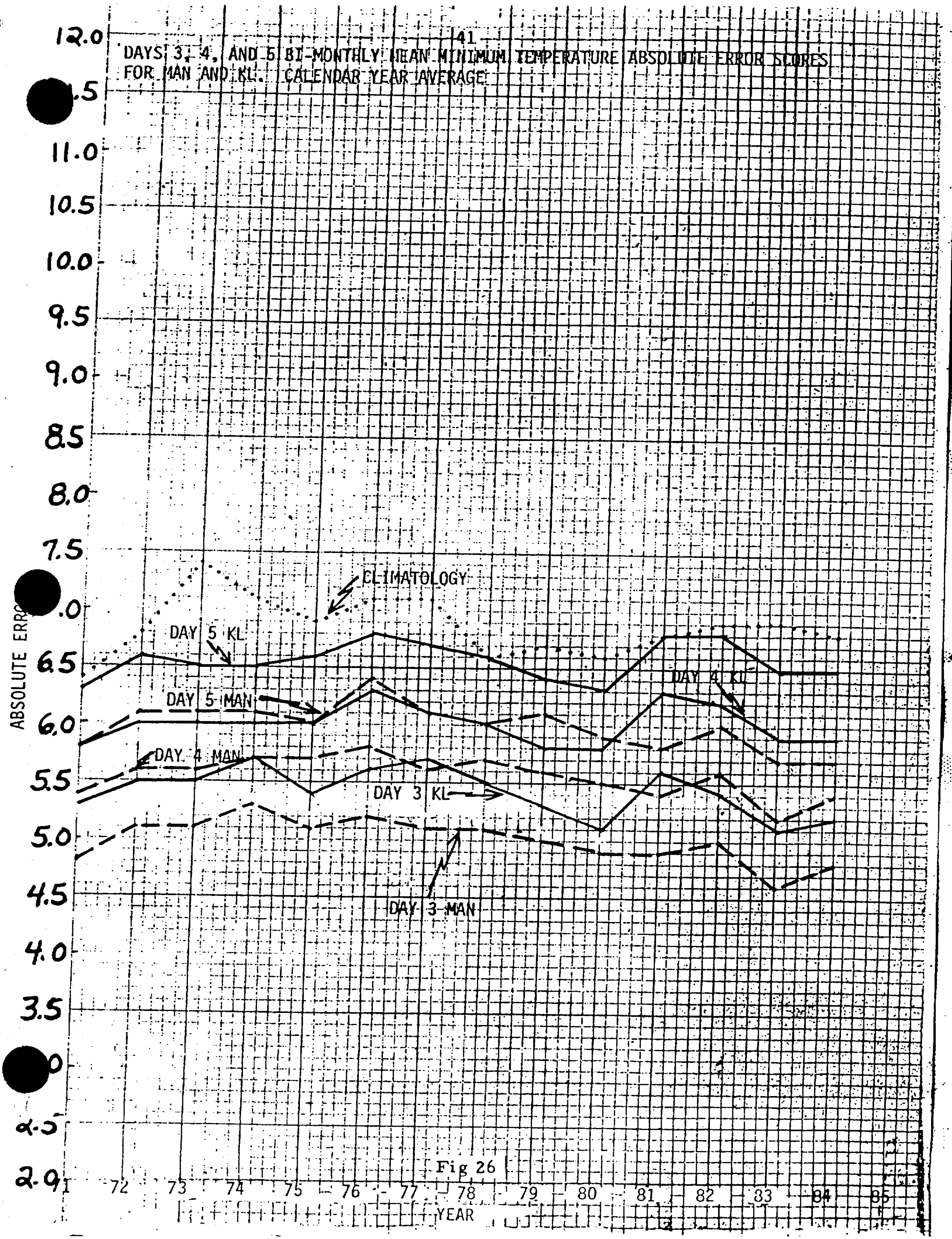

DAYS 3, 4, AND 5 BI-MONTHLY MEAN MINIMUM TEMPERATURE ABSOLUTE ERROR SCORES FOR MAN AND KL. CALENDAR YEAR AVERAGE
CLIMATOLOGY
DAY 5 KL
DAY 5 MAN
DAY 4 KL
DAY 4 MAN
DAY 3 KL
DAY 3 MAN
ABSOLUTE ERROR
YEAR
12.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
6.5
6.0
5.5
5.0
4.5
4.0
3.5
72
73
74
75
76
77
78
79
80
81
82
83
84
85

Fig 26

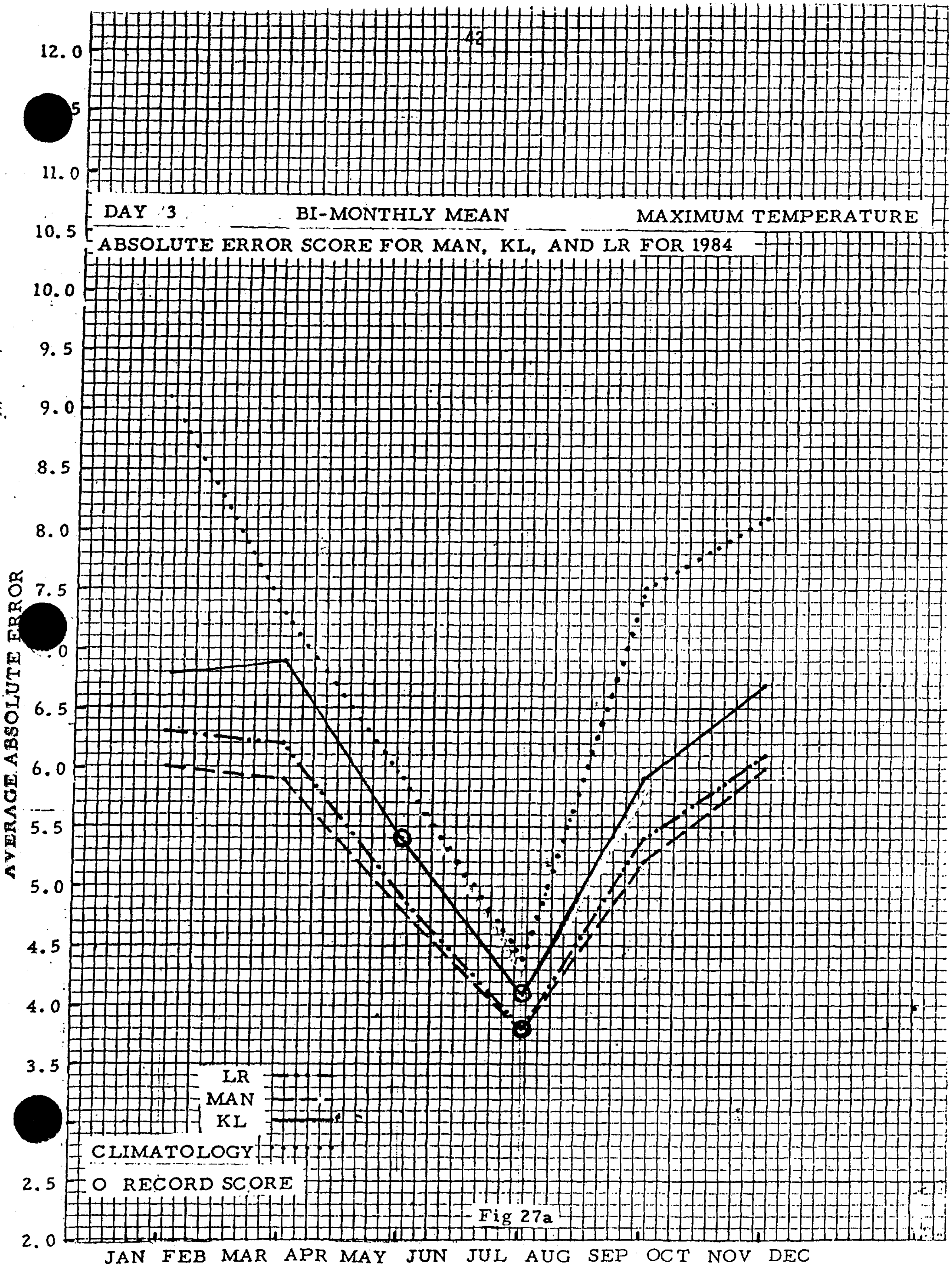

DAY 3
BI-MONTHLY MEAN
MAXIMUM TEMPERATURE
ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR FOR 1984
AVERAGE ABSOLUTE ERROR
12.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
O RECORD SCORE
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 27a

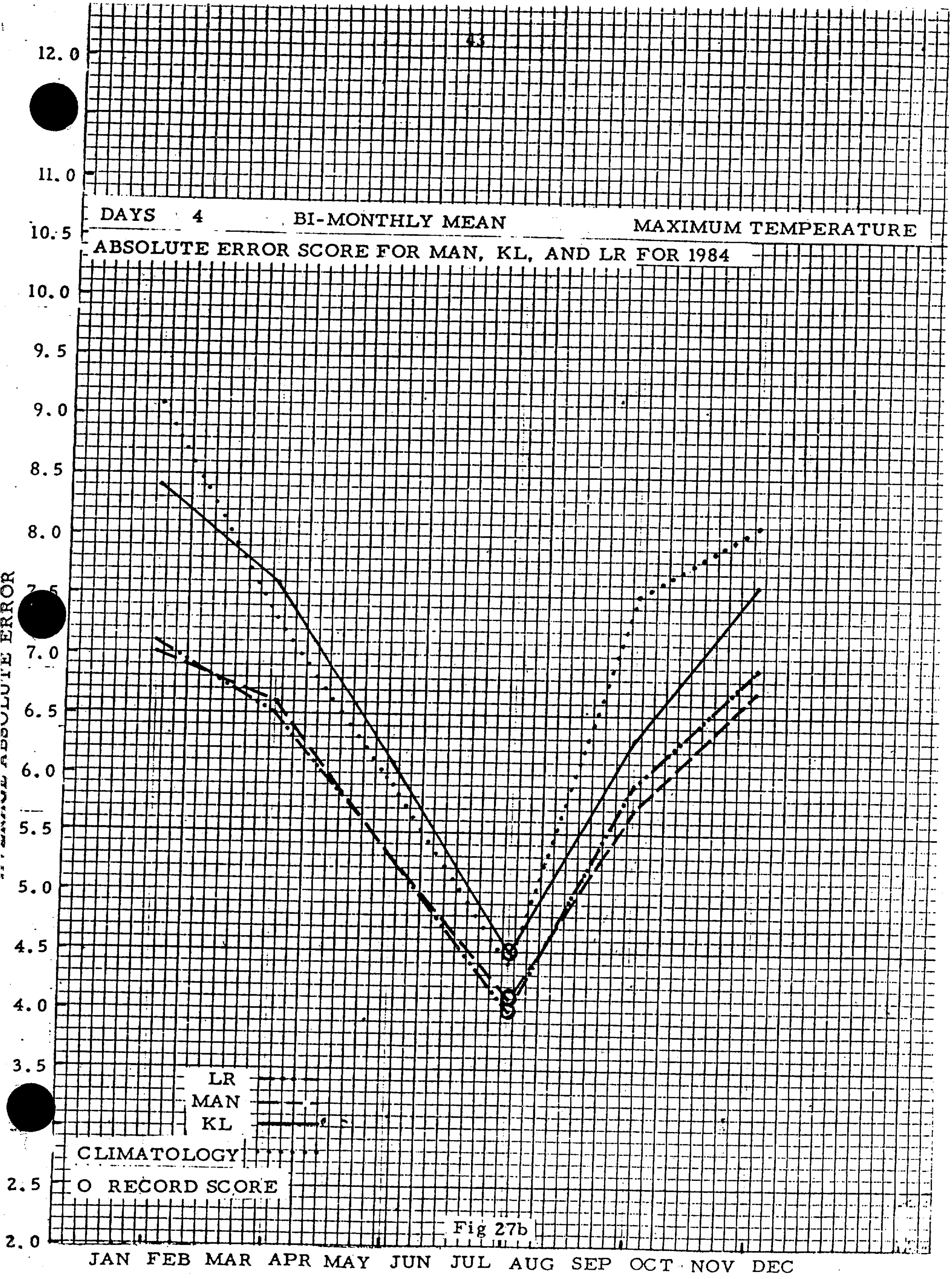

DAYS 4
BI-MONTHLY MEAN
MAXIMUM TEMPERATURE
ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR FOR 1984
12.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2.5
2.0
ABSOLUTE ERROR
LR
MAN
KL
CLIMATOLOGY
O RECORD SCORE
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 27b

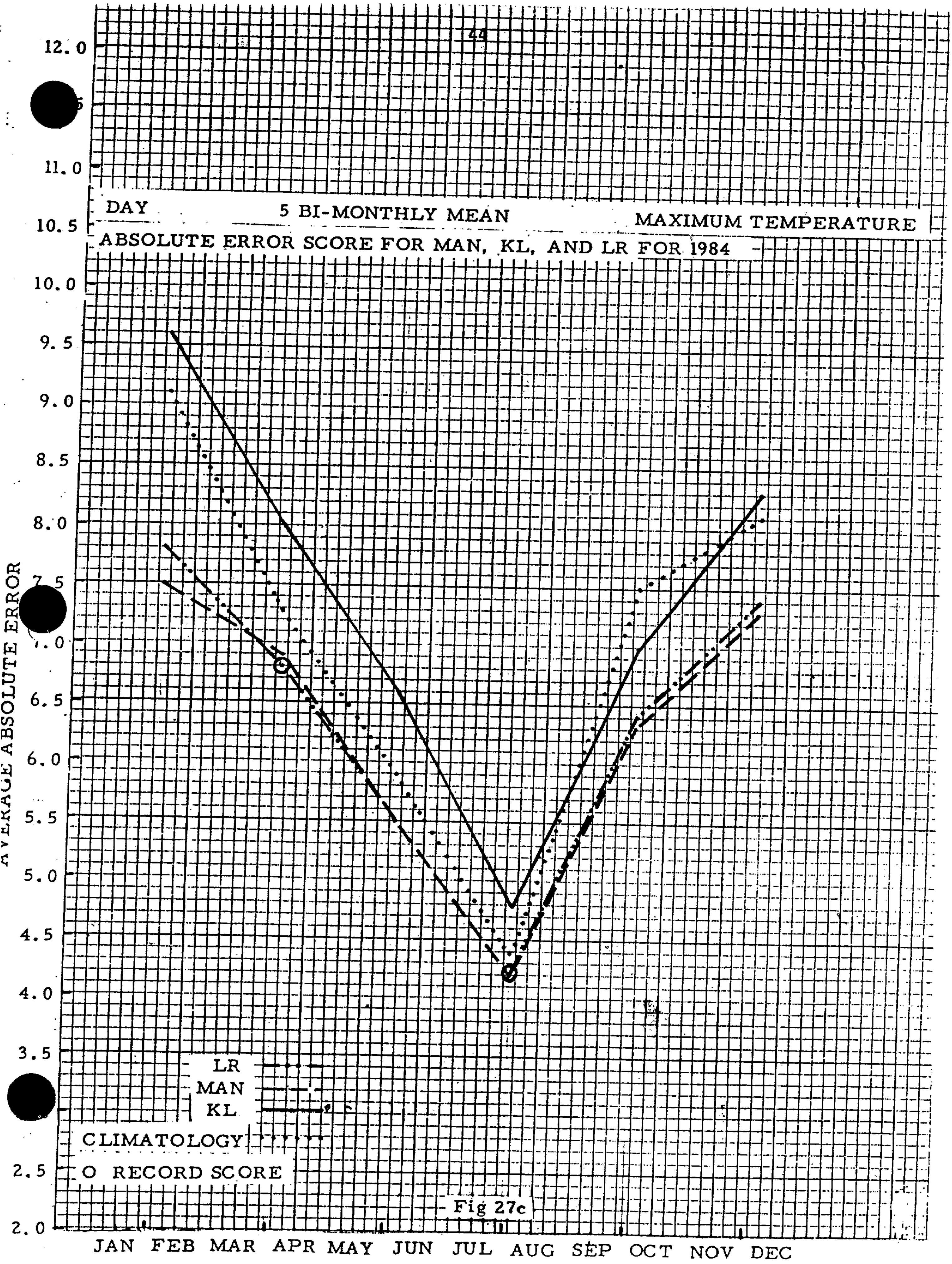

DAY
5 BI-MONTHLY MEAN
MAXIMUM TEMPERATURE
ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR FOR 1984
AVERAGE ABSOLUTE ERROR
12.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
O RECORD SCORE
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 27c

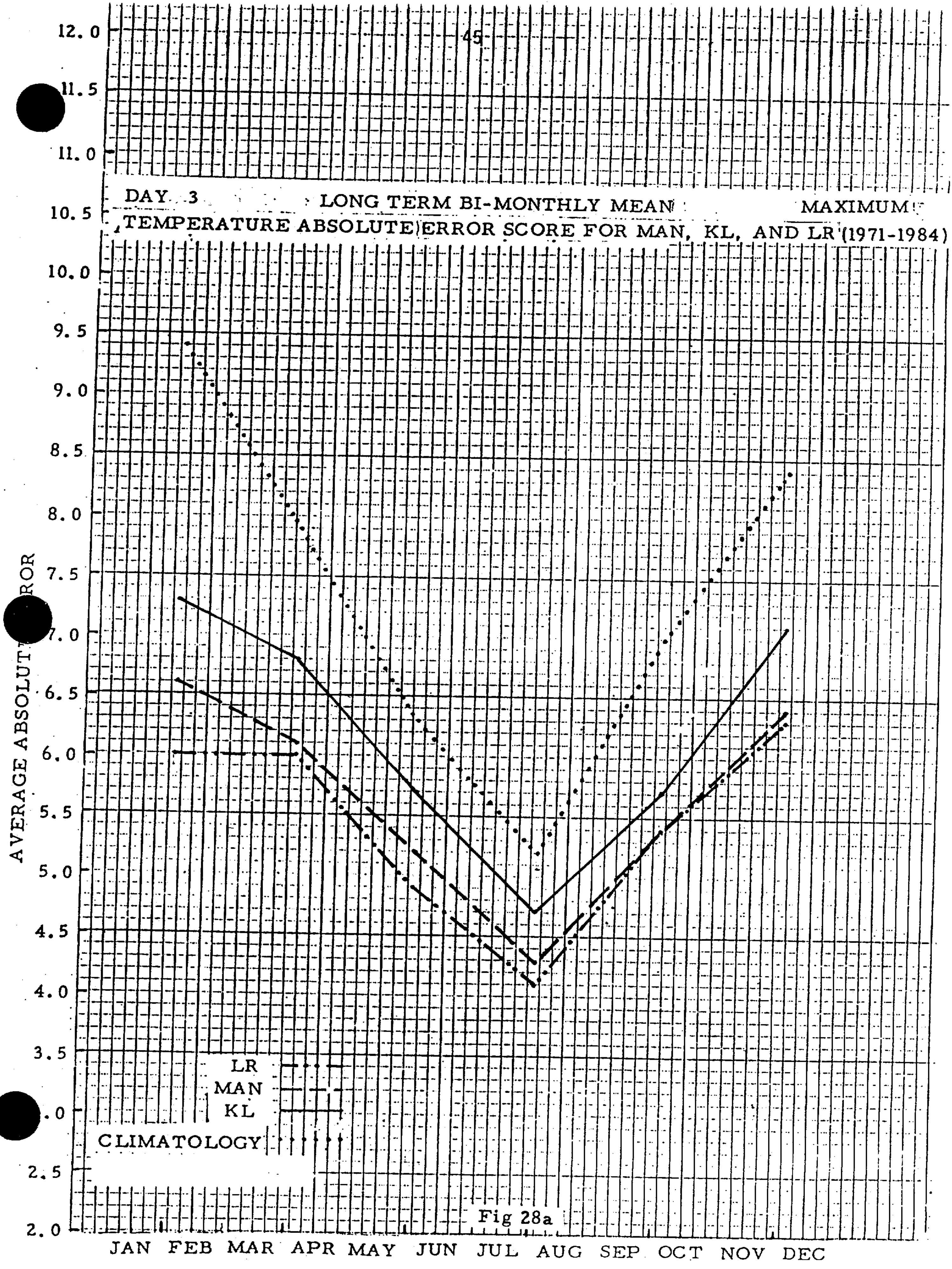

DAY 3 LONG TERM BI-MONTHLY MEAN MAXIMUM
TEMPERATURE ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR (1971-1984)
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 28a

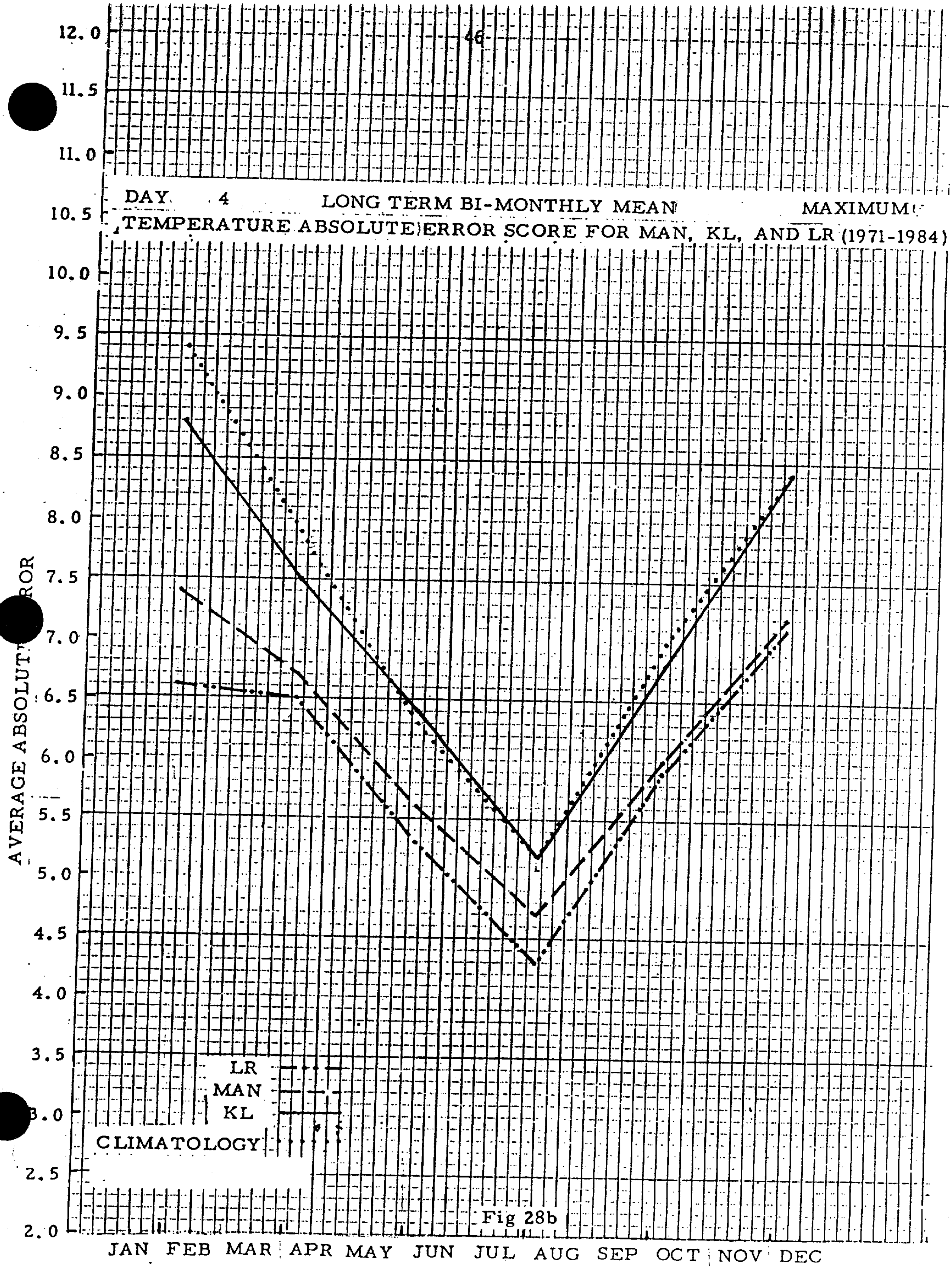
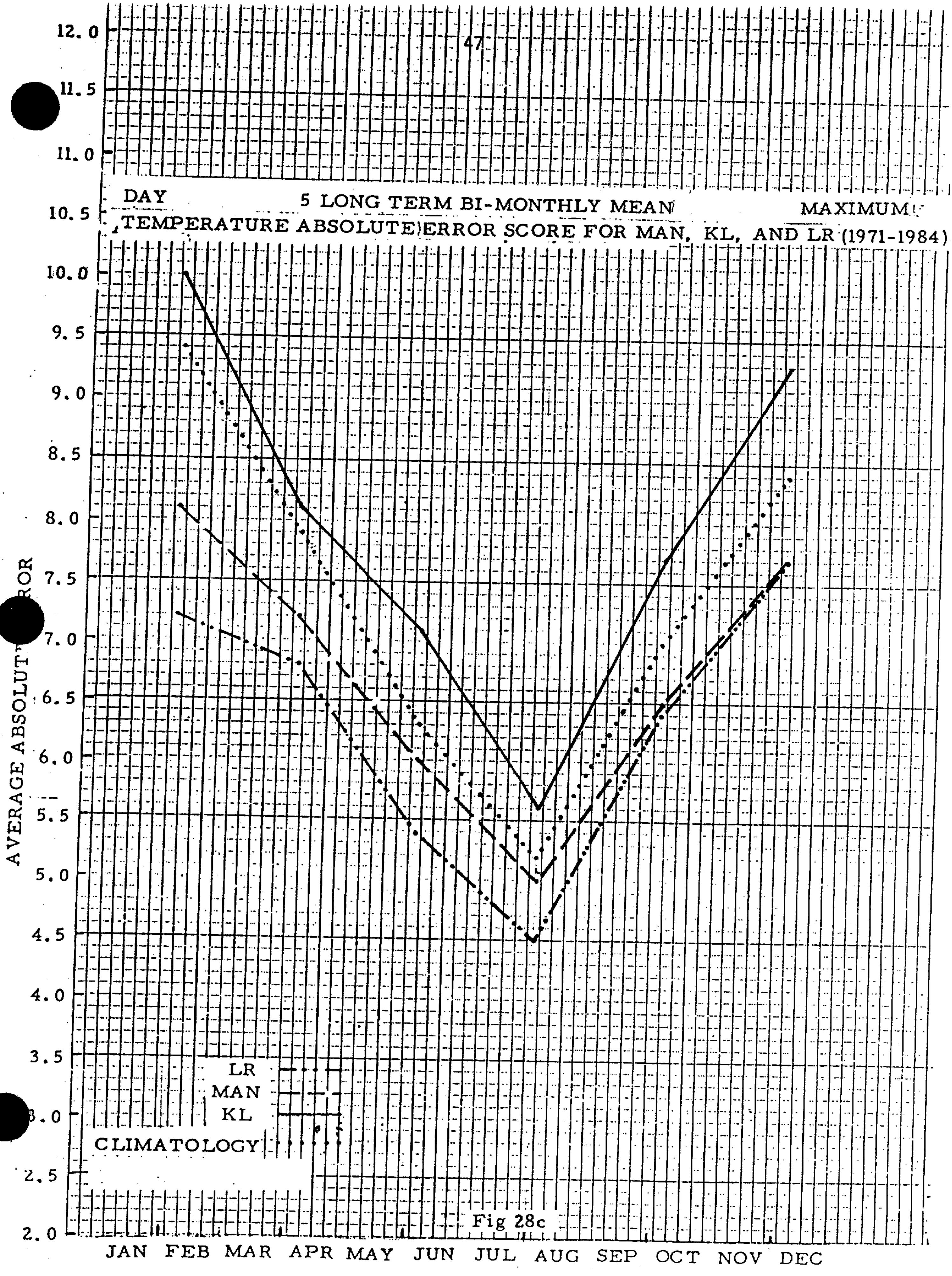

DAY 4 LONG TERM BI-MONTHLY MEAN MAXIMUM
TEMPERATURE ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR (1971-1984)
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
LR
MAN
KL
CLIMATOLOGY

Fig 28b



DAY 5 LONG TERM BI-MONTHLY MEAN MAXIMUM
TEMPERATURE ABSOLUTE ERROR SCORE FOR MAN, KL, AND LR (1971-1984)
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
LR
MAN
KL
CLIMATOLOGY
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 28c

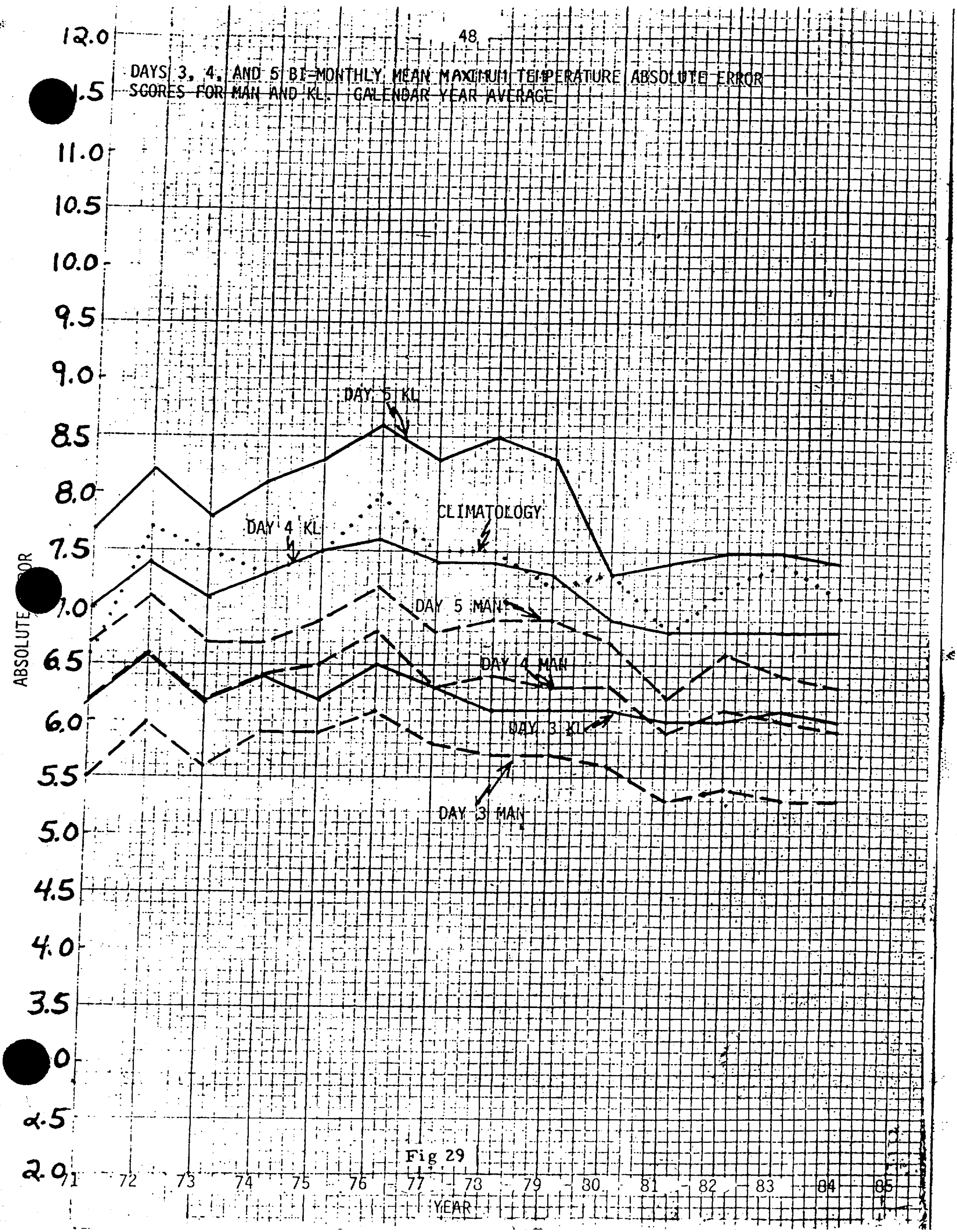

DAYS 3, 4, AND 5 BI-MONTHLY MEAN MAXIMUM TEMPERATURE ABSOLUTE ERROR
SCORES FOR MAN AND KL. CALENDAR YEAR AVERAGE
DAY 5 KL
CLIMATOLOGY
DAY 4 KL
DAY 5 MAN
DAY 4 MAN
DAY 3 KL
DAY 3 MAN
ABSOLUTE ERROR
YEAR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85

Fig 29

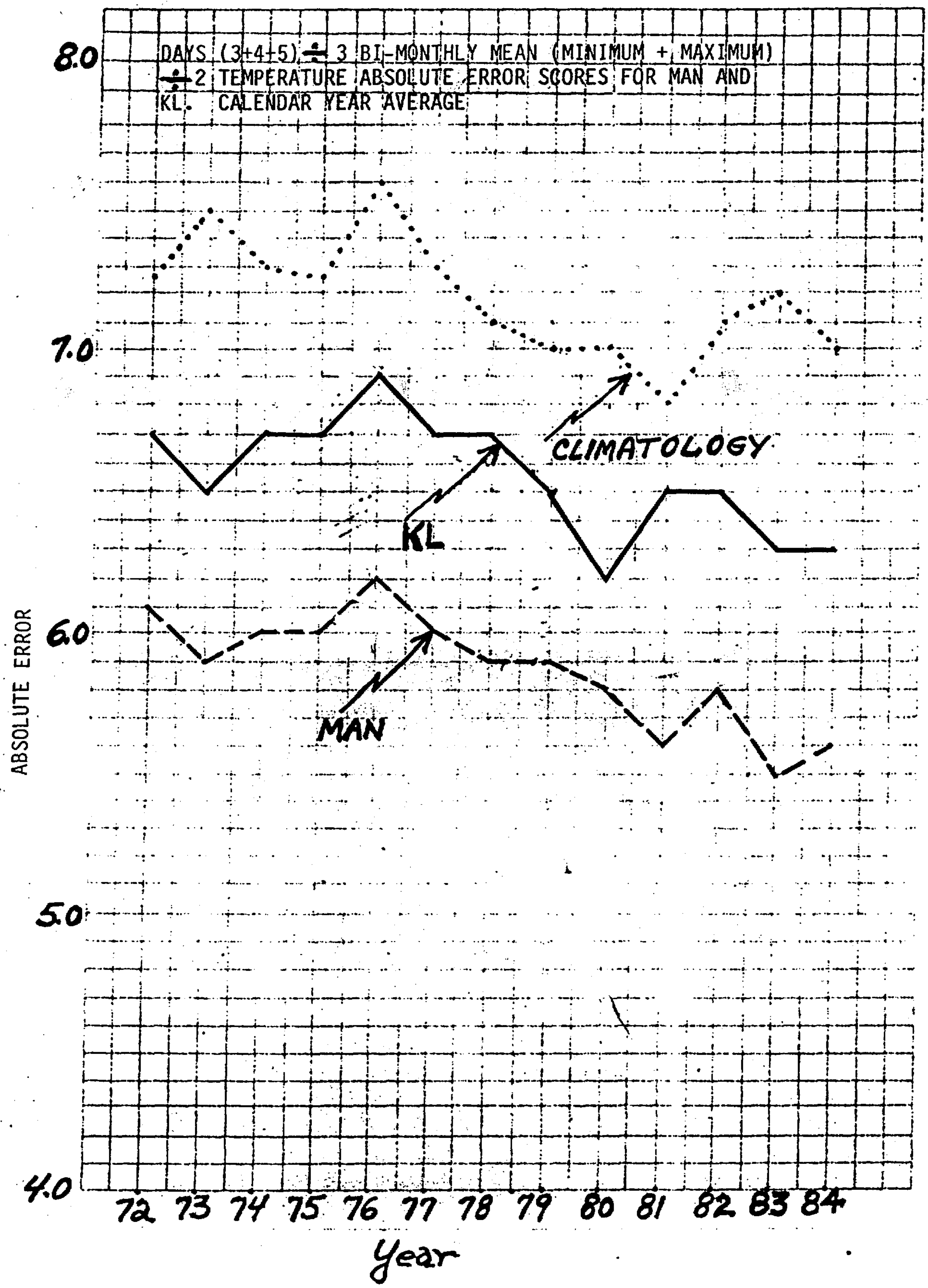

DAYS (3+4+5) ÷ 3 BI-MONTHLY MEAN (MINIMUM + MAXIMUM) ÷ 2 TEMPERATURE ABSOLUTE ERROR SCORES FOR MAN AND KL. CALENDAR YEAR AVERAGE
8.0
7.0
6.0
5.0
4.0
ABSOLUTE ERROR
CLIMATOLOGY
KL
MAN
72
73
74
75
76
77
78
79
80
81
82
83
84
Year

Figure 30

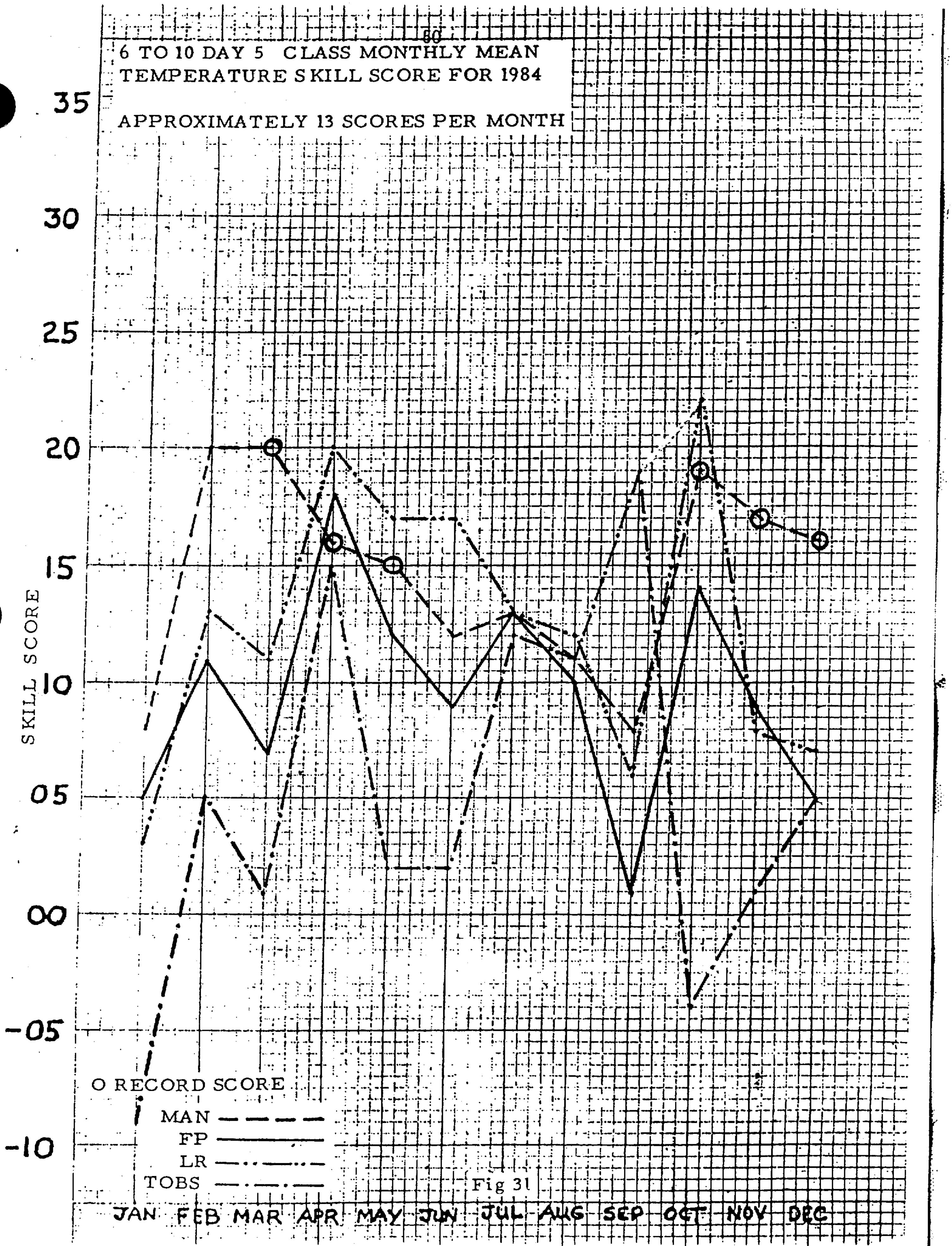

6 TO 10 DAY 5 CLASS MONTHLY MEAN
TEMPERATURE SKILL SCORE FOR 1984
APPROXIMATELY 13 SCORES PER MONTH
SKILL SCORE
35
30
25
20
15
10
05
00
-05
-10
O RECORD SCORE
MAN
FP
LR
TOBS
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 31

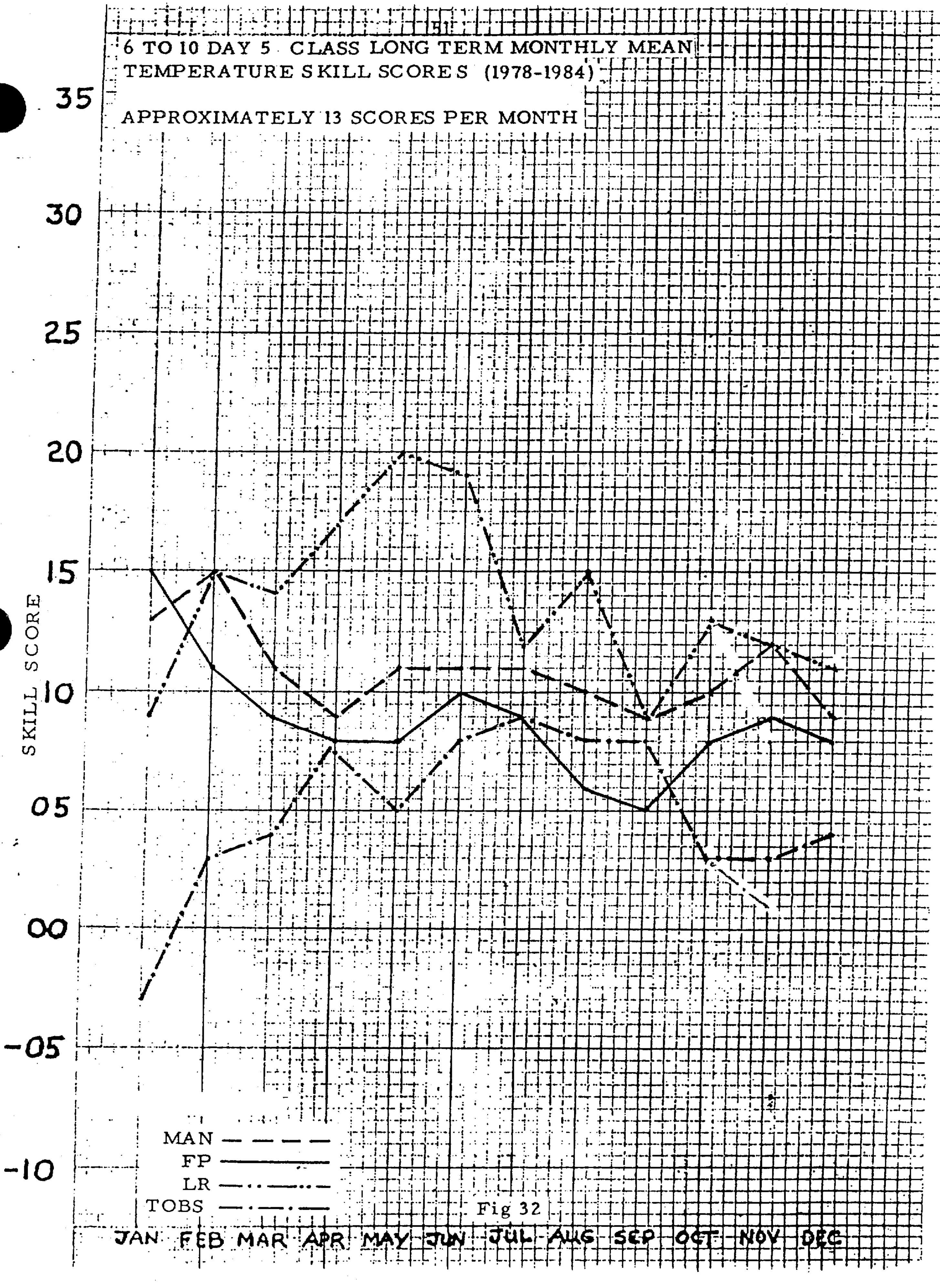

6 TO 10 DAY 5 CLASS LONG TERM MONTHLY MEAN
TEMPERATURE SKILL SCORES (1978-1984)
APPROXIMATELY 13 SCORES PER MONTH
35
30
25
20
15
10
05
00
-05
-10
SKILL SCORE
MAN
FP
LR
TOBS
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig 32

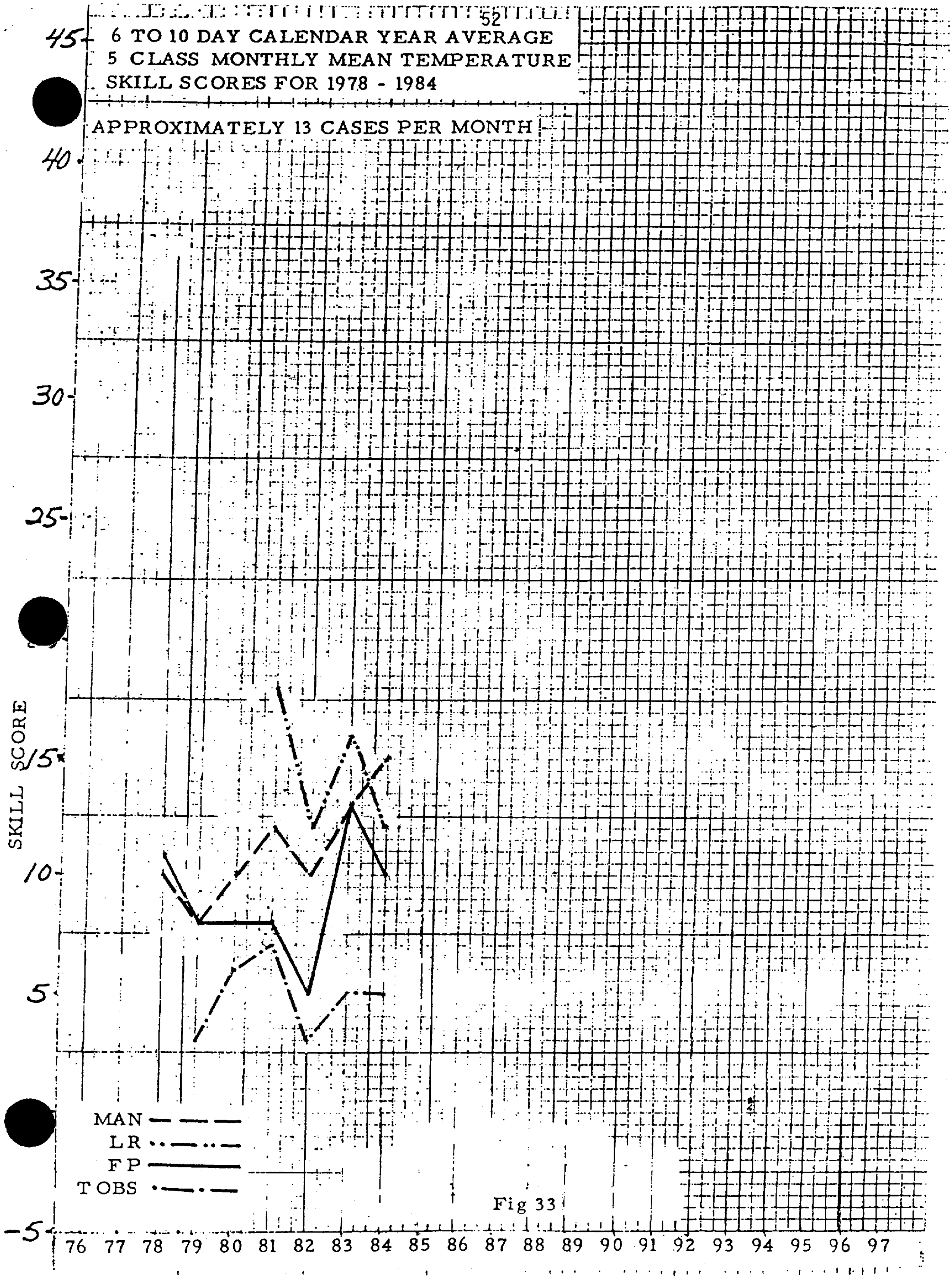

6 TO 10 DAY CALENDAR YEAR AVERAGE
5 CLASS MONTHLY MEAN TEMPERATURE
SKILL SCORES FOR 1978 - 1984
APPROXIMATELY 13 CASES PER MONTH
SKILL SCORE
45
40
35
30
25
15
10
5
-5
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97
MAN
LR
FP
T OBS

Fig 33

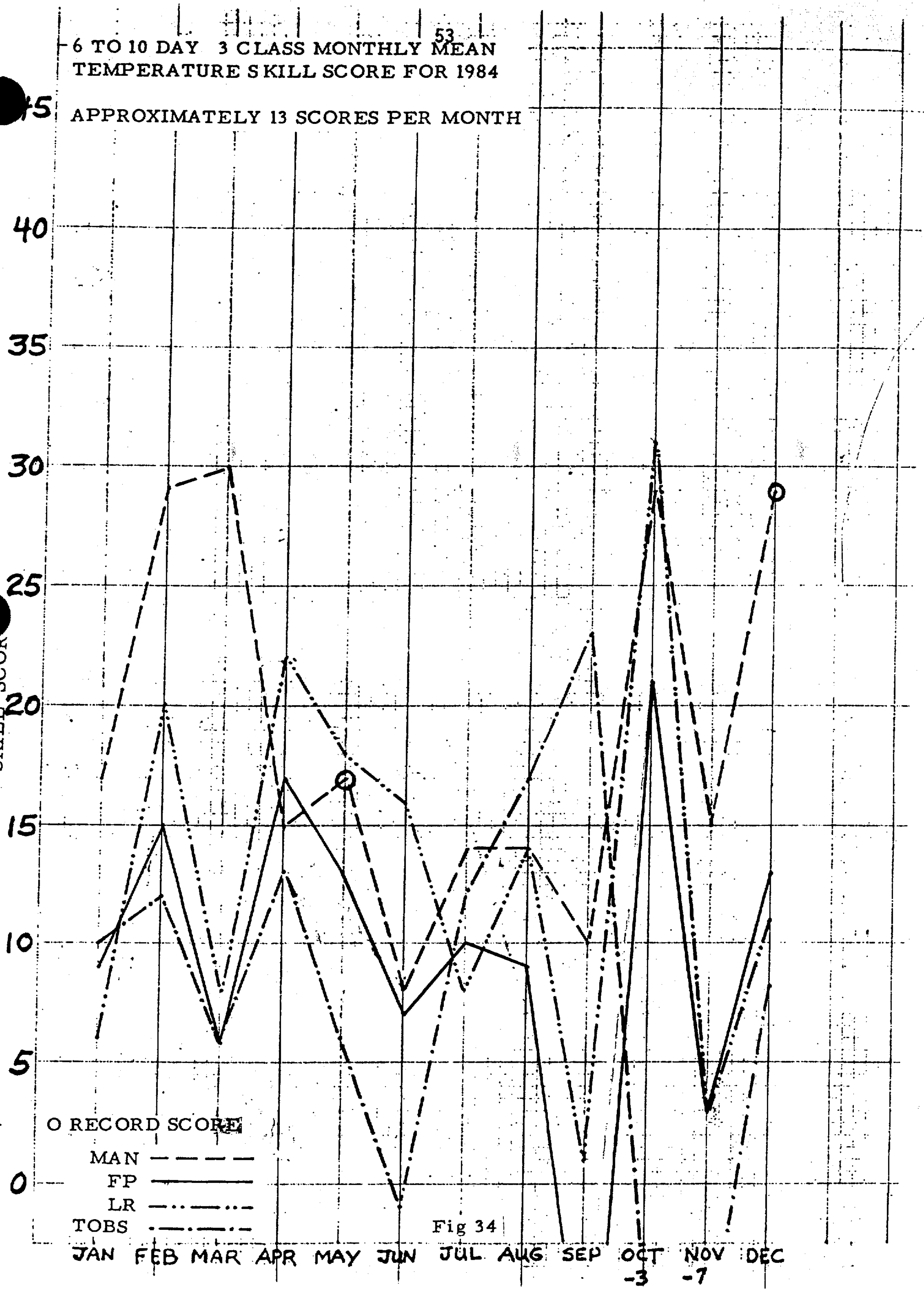

6 TO 10 DAY 3 CLASS MONTHLY MEAN
TEMPERATURE SKILL SCORE FOR 1984
APPROXIMATELY 13 SCORES PER MONTH
SKILL SCORE
45
40
35
30
25
20
15
10
5
0
O RECORD SCORE
MAN
FP
LR
TOBS
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
-3
-7

Fig 34

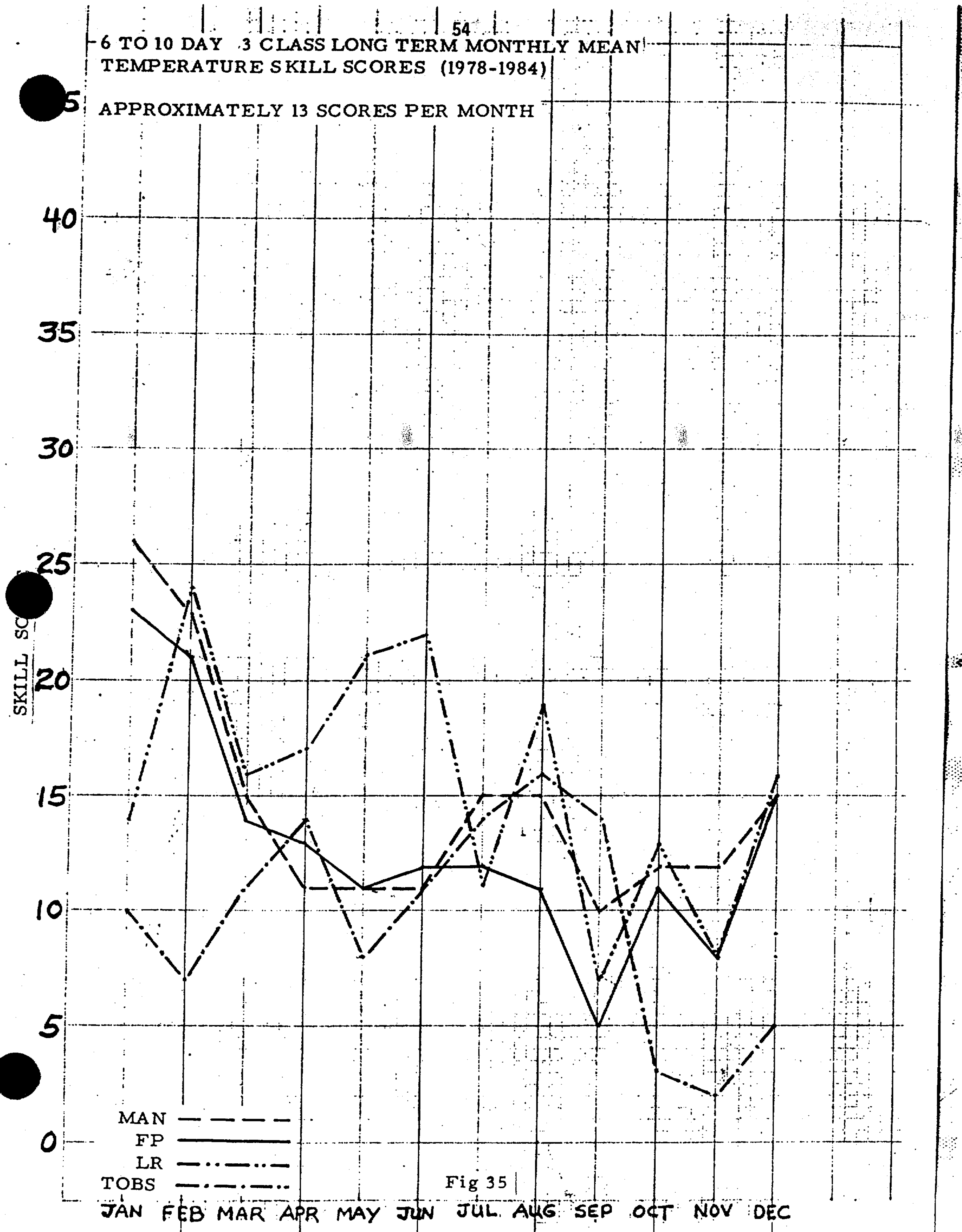

6 TO 10 DAY 3 CLASS LONG TERM MONTHLY MEAN
TEMPERATURE SKILL SCORES (1978-1984)
APPROXIMATELY 13 SCORES PER MONTH
45
40
35
30
25
20
15
10
5
0
SKILL SC
MAN
FP
LR
TOBS
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 35

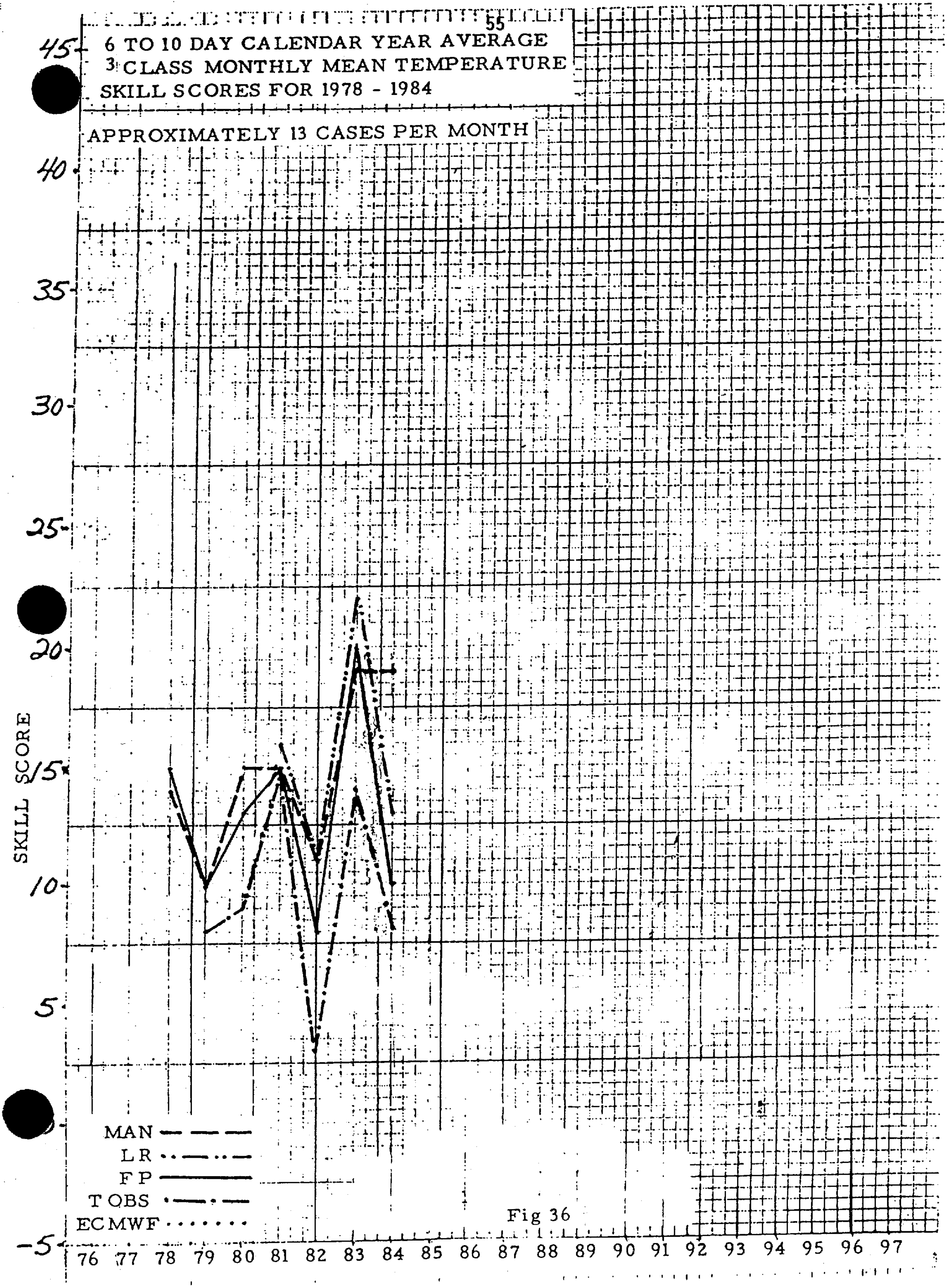

6 TO 10 DAY CALENDAR YEAR AVERAGE
3 CLASS MONTHLY MEAN TEMPERATURE
SKILL SCORES FOR 1978 - 1984
APPROXIMATELY 13 CASES PER MONTH
SKILL SCORE
45
40
35
30
25
20
15
10
5
-5
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97
MAN
LR
FP
T OBS
ECMWF

Fig 36

SECTION 3

Man & Climatology

Precipitation Skill Scores

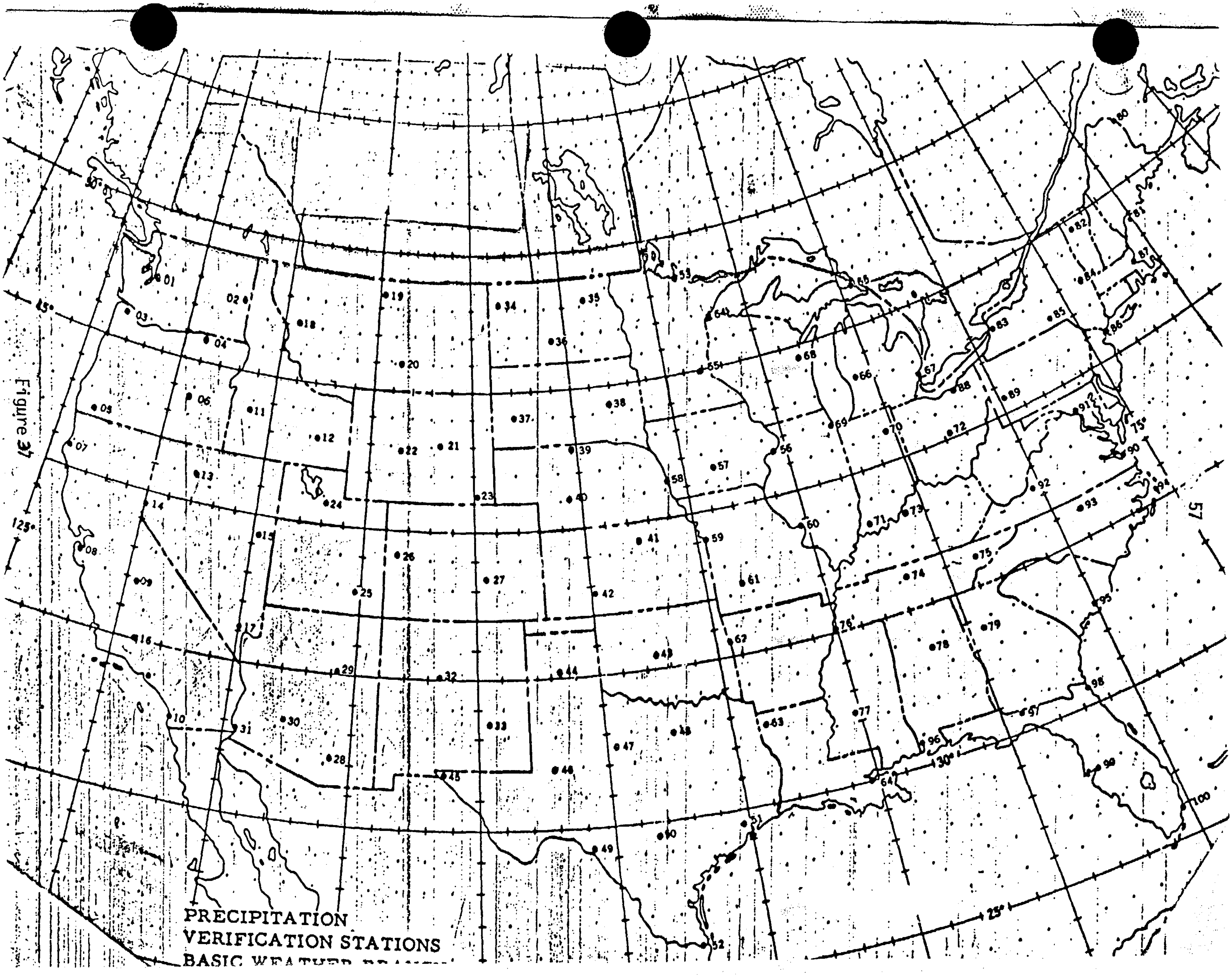


Figure 37

PRECIPITATION
VERIFICATION STATIONS
BASIC WEATHER BRA...

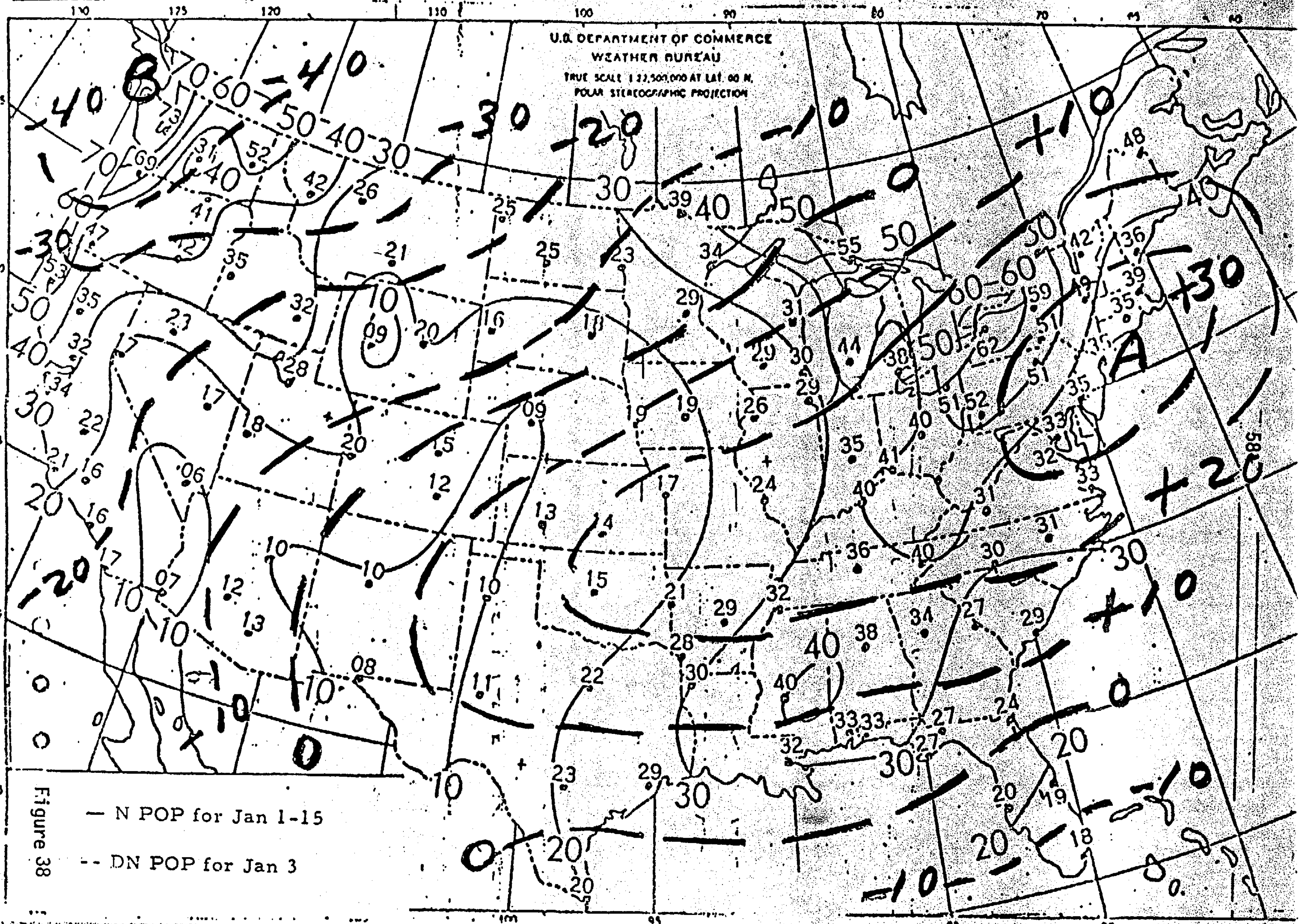
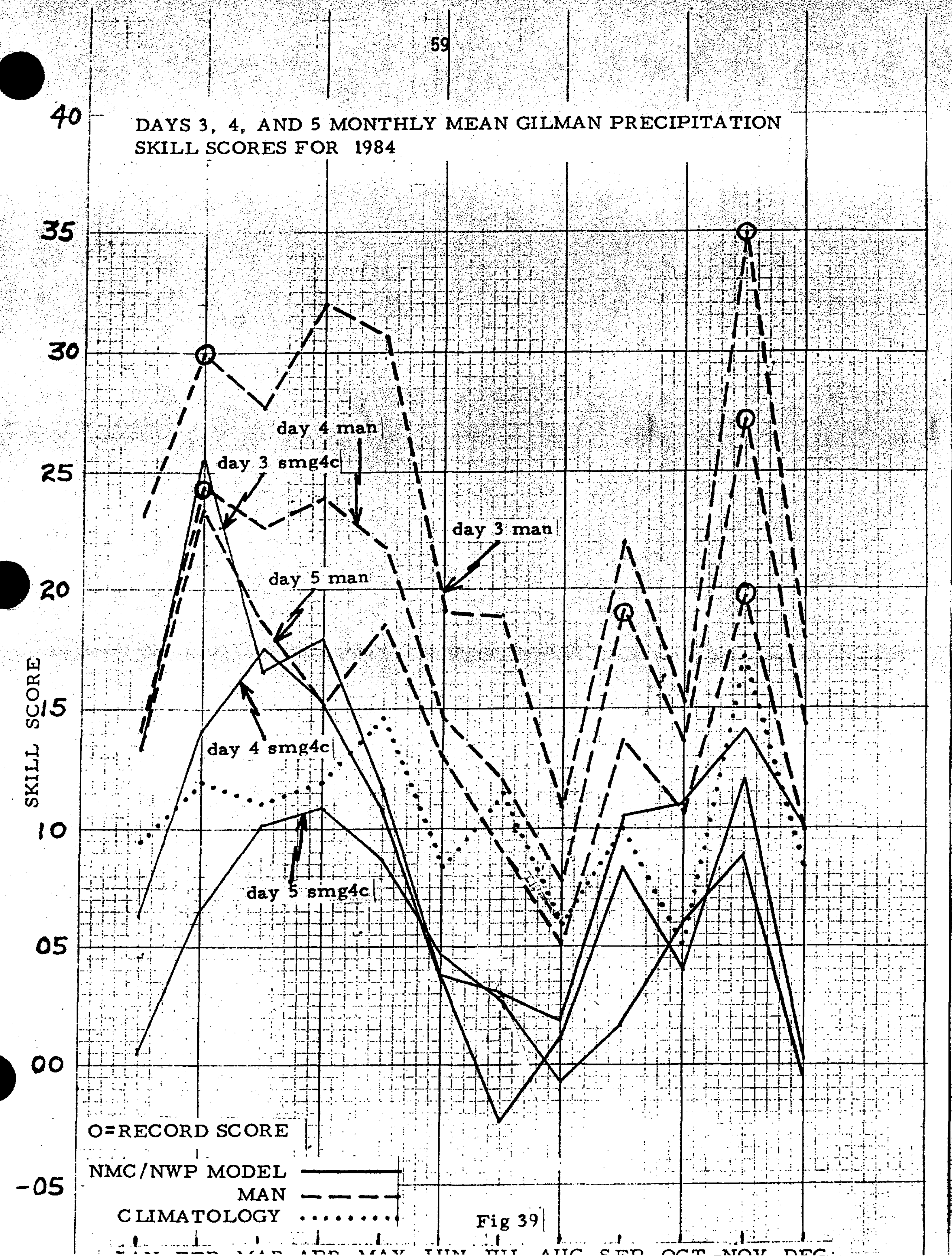

U.S. DEPARTMENT OF COMMERCE
WEATHER BUREAU
TRUE SCALE 1:22,500,000 AT LAT. 60 N.
POLAR STEREOGRAPHIC PROJECTION
— N POP for Jan 1-15
-- DN POP for Jan 3

Figure 38



DAYS 3, 4, AND 5 MONTHLY MEAN GILMAN PRECIPITATION SKILL SCORES FOR 1984
40
35
30
25
20
15
10
05
00
-05
SKILL SCORE
day 4 man
day 3 smg4c
day 3 man
day 5 man
day 4 smg4c
day 5 smg4c
O=RECORD SCORE
NMC/NWP MODEL
MAN
CLIMATOLOGY

Fig 39

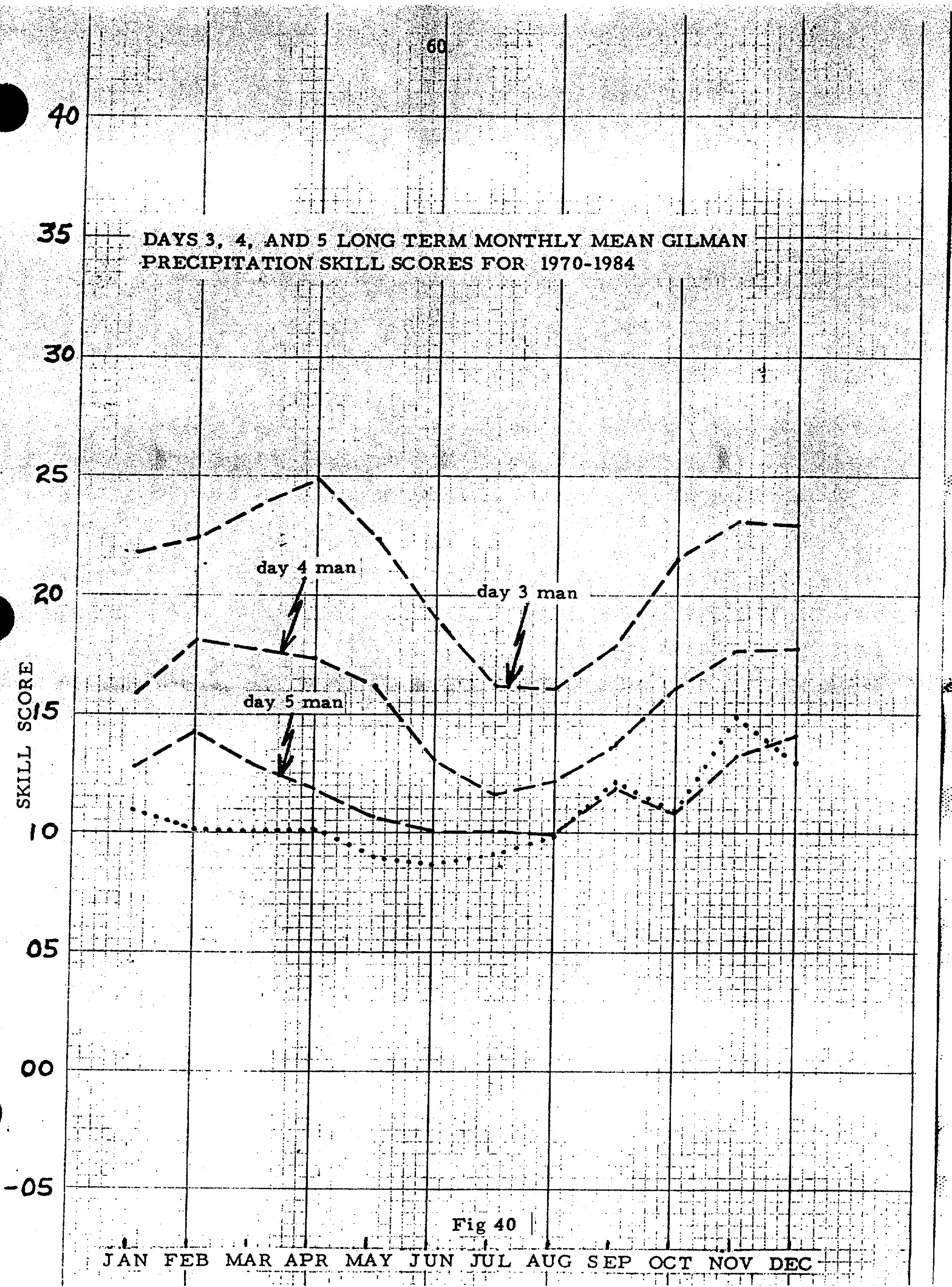

DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN GILMAN
PRECIPITATION SKILL SCORES FOR 1970-1984
SKILL SCORE
40
35
30
25
20
15
10
05
00
-05
day 4 man
day 3 man
day 5 man
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 40

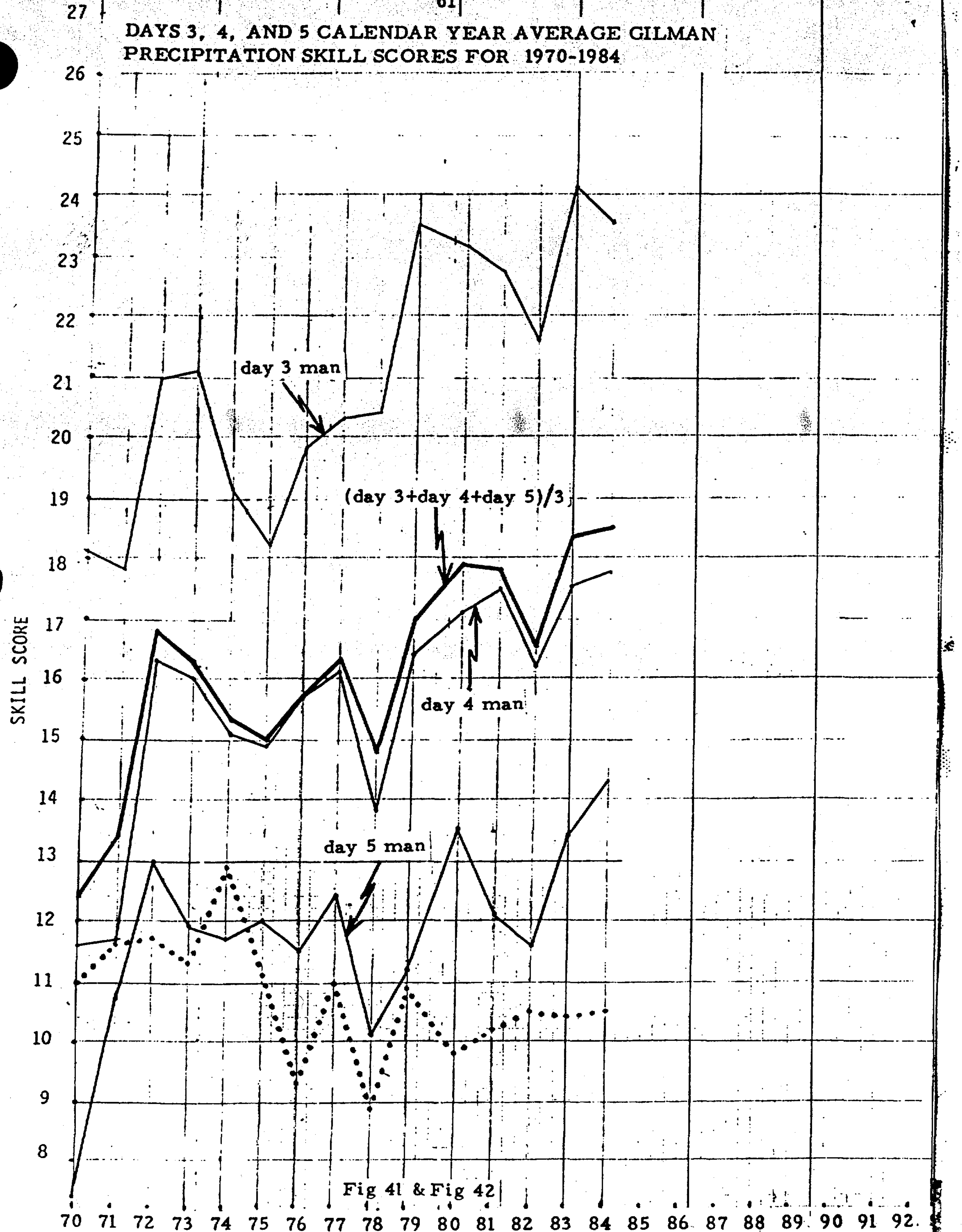

DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE GILMAN PRECIPITATION SKILL SCORES FOR 1970-1984
SKILL SCORE
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
day 3 man
(day 3+day 4+day 5)/3
day 4 man
day 5 man
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92

Fig 41 & Fig 42

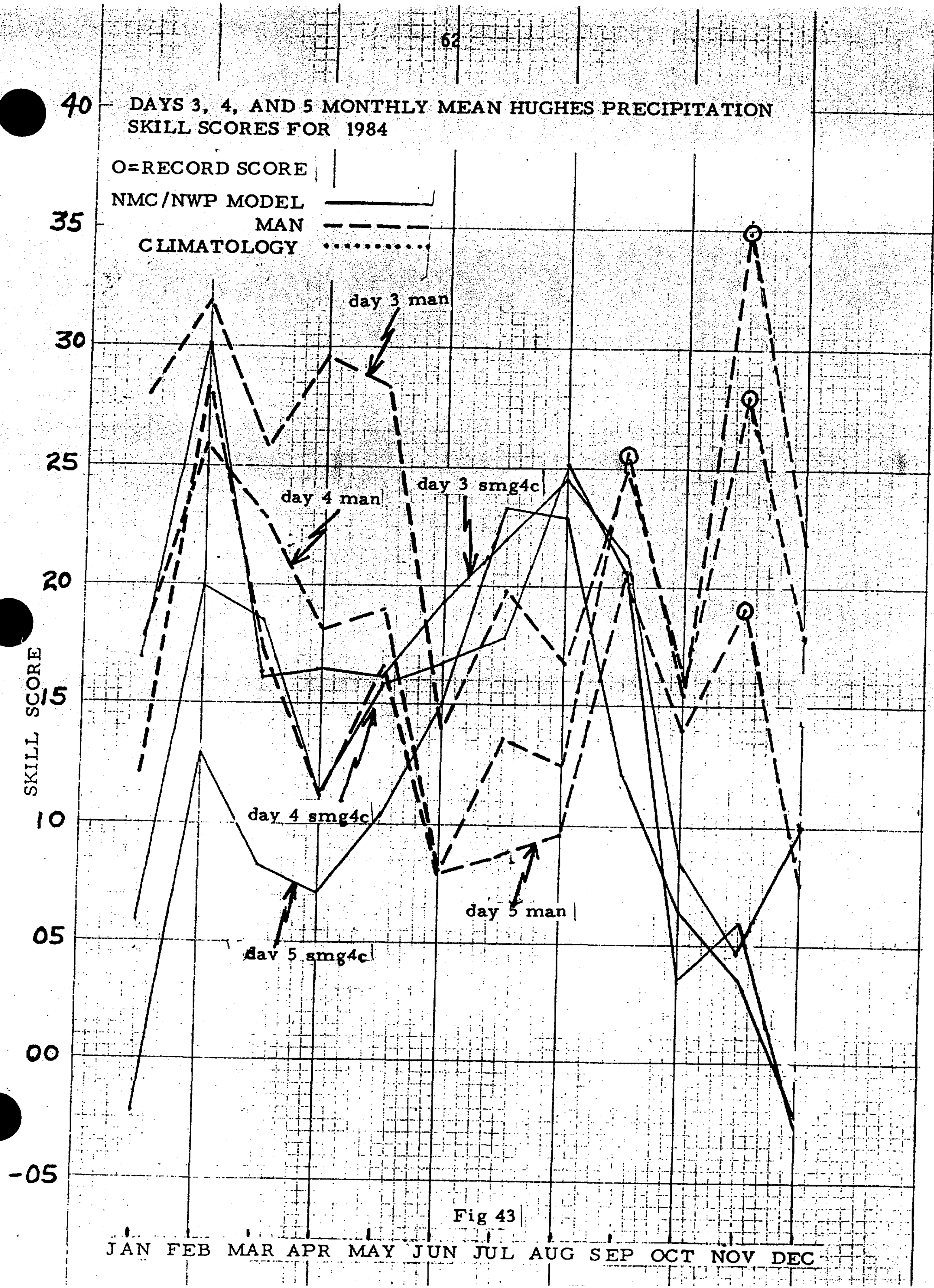

DAYS 3, 4, AND 5 MONTHLY MEAN HUGHES PRECIPITATION
SKILL SCORES FOR 1984
O=RECORD SCORE
NMC/NWP MODEL
MAN
CLIMATOLOGY
day 3 man
day 4 man
day 3 smg4c
day 4 smg4c
day 5 man
day 5 smg4c
SKILL SCORE
40
35
30
25
20
15
10
05
00
-05
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig 43

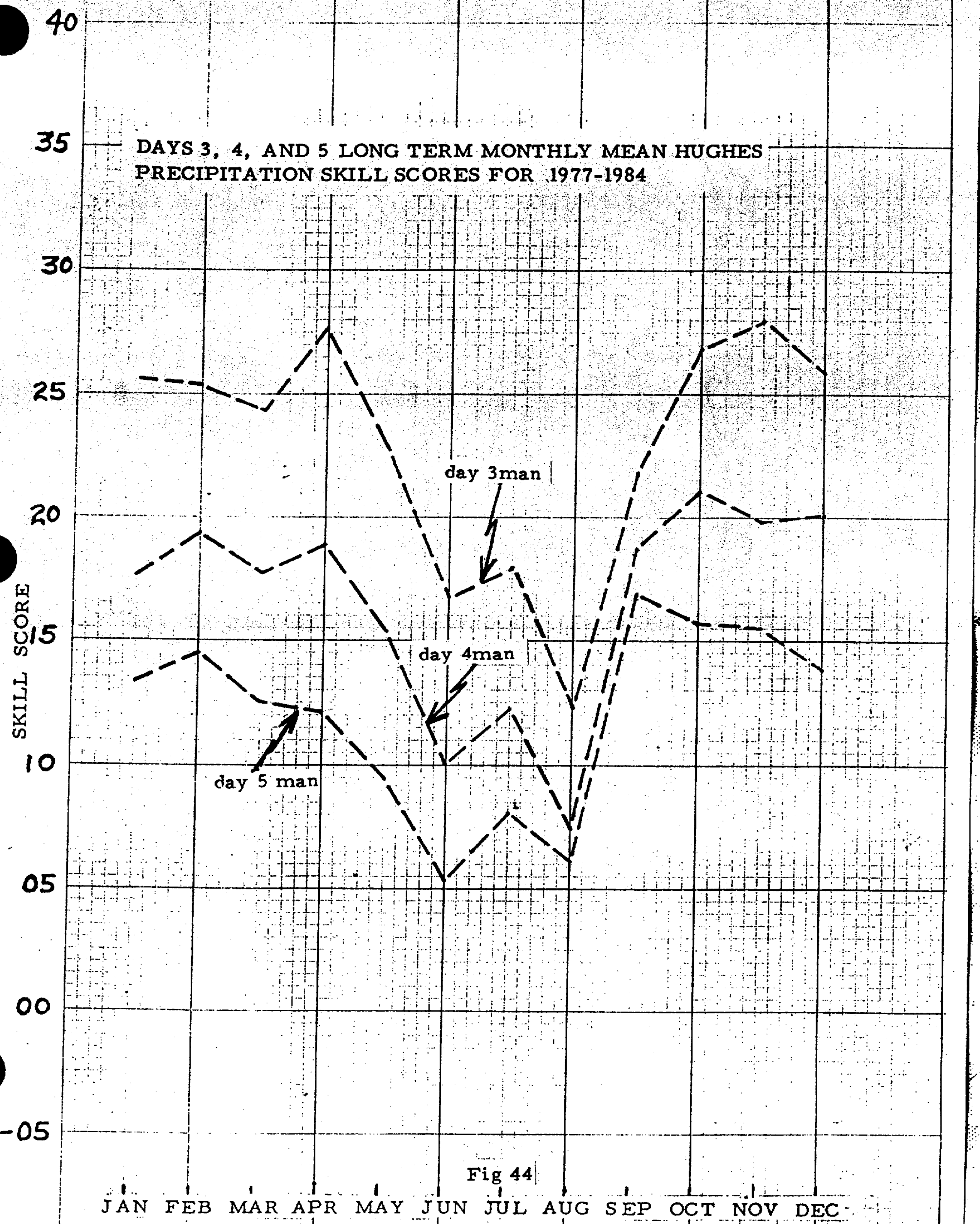

DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN HUGHES
PRECIPITATION SKILL SCORES FOR 1977-1984
SKILL SCORE
40
35
30
25
20
15
10
05
00
-05
day 3man
day 4man
day 5 man
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig 44

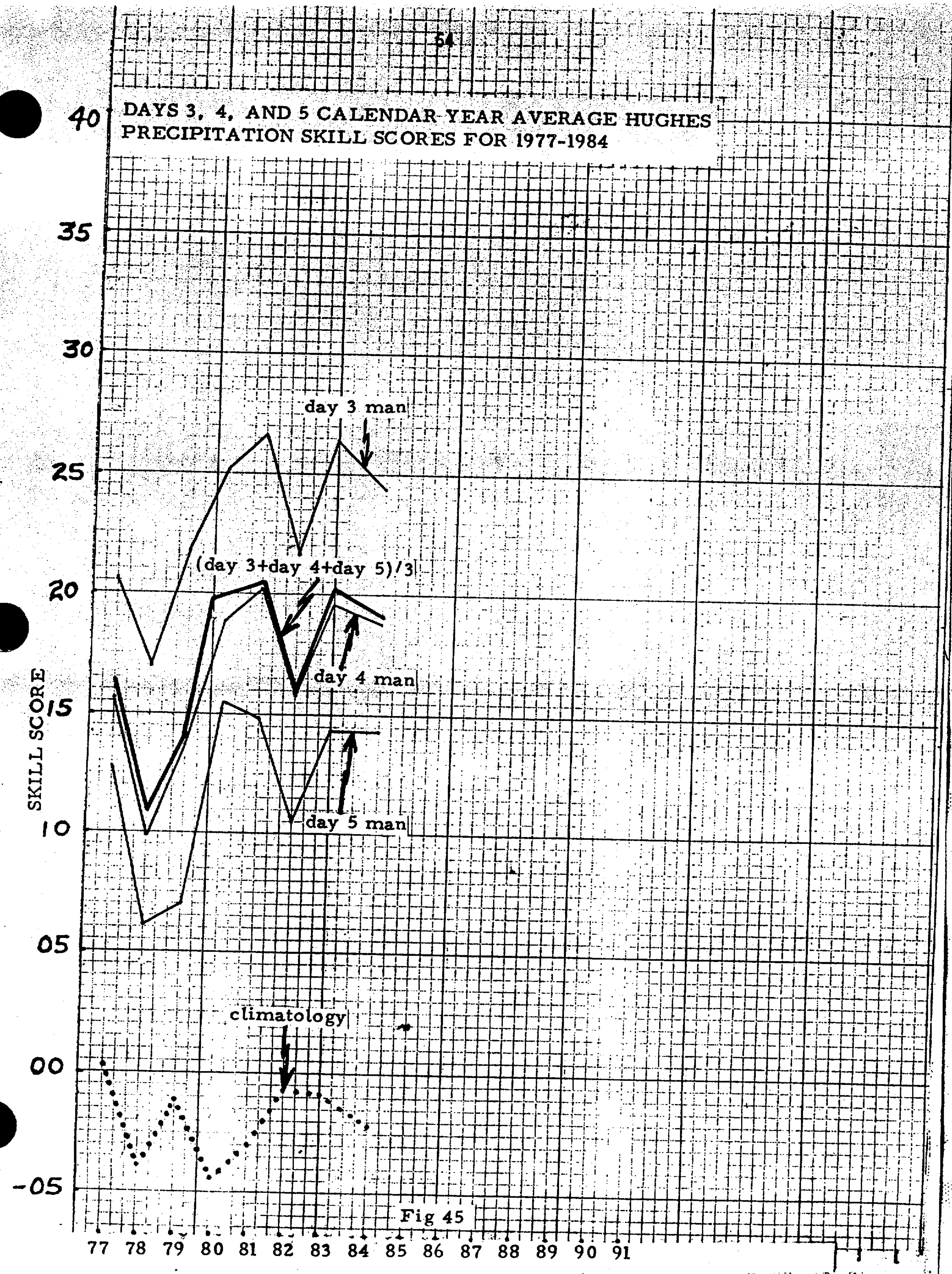

DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE HUGHES PRECIPITATION SKILL SCORES FOR 1977-1984
40
35
30
25
20
15
10
05
00
-05
SKILL SCORE
day 3 man
(day 3+day 4+day 5)/3
day 4 man
day 5 man
climatology
77 78 79 80 81 82 83 84 85 86 87 88 89 90 91

Fig 45

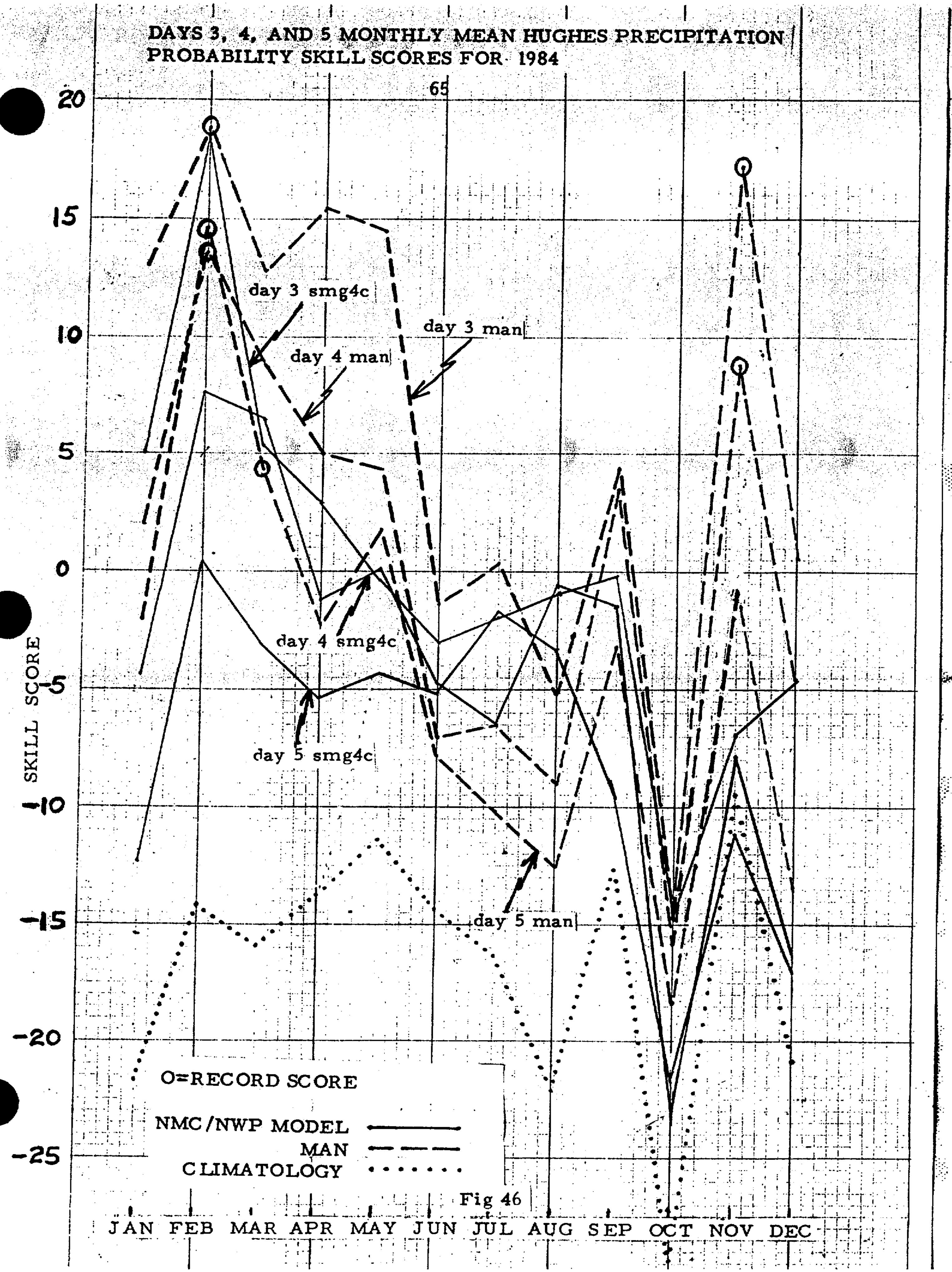

DAYS 3, 4, AND 5 MONTHLY MEAN HUGHES PRECIPITATION
PROBABILITY SKILL SCORES FOR 1984
20
15
10
5
0
-5
-10
-15
-20
-25
SKILL SCORE
day 3 smg4c
day 3 man
day 4 man
day 4 smg4c
day 5 smg4c
day 5 man
O=RECORD SCORE
NMC/NWP MODEL
MAN
CLIMATOLOGY
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 46

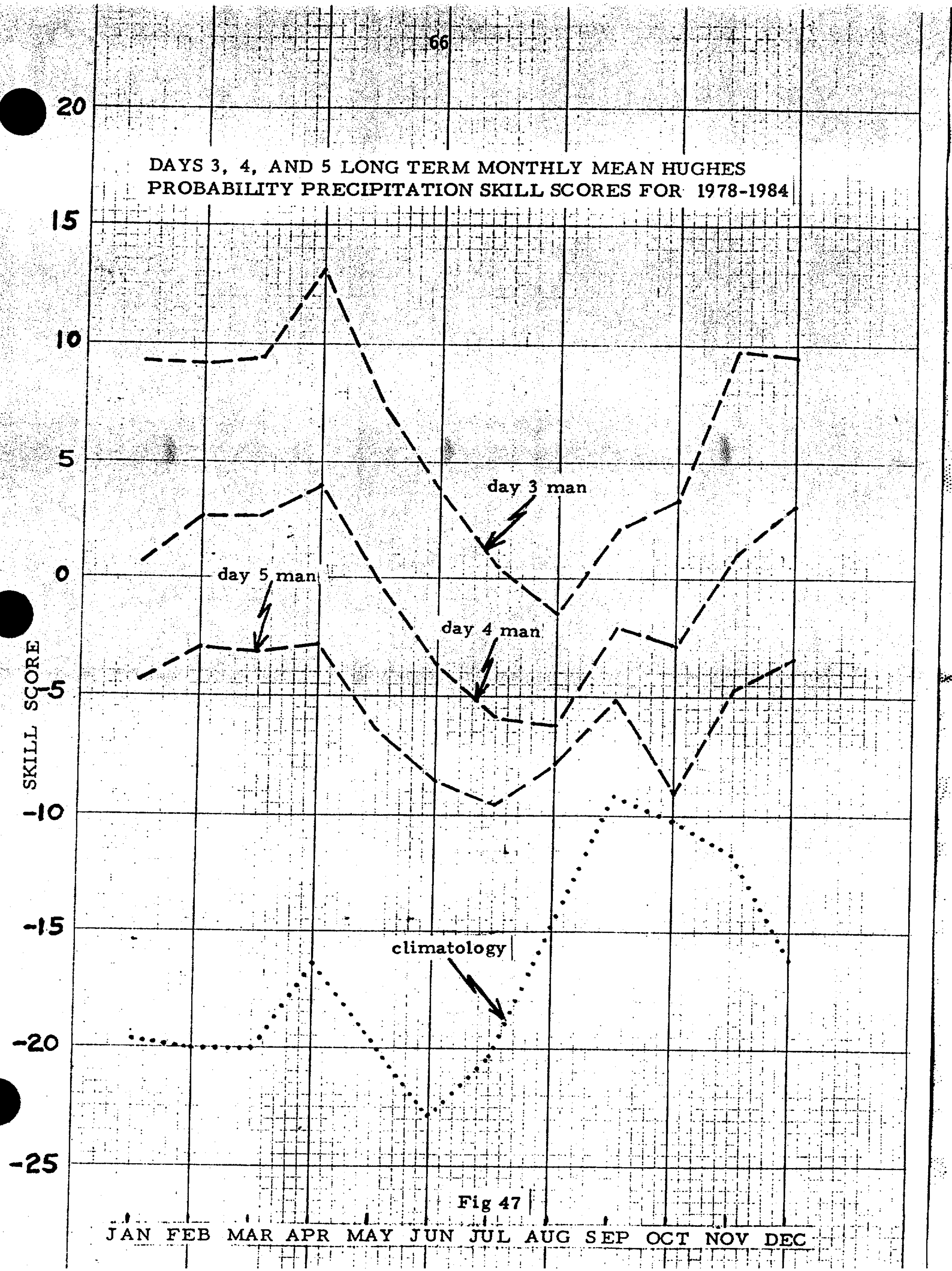

DAYS 3, 4, AND 5 LONG TERM MONTHLY MEAN HUGHES
PROBABILITY PRECIPITATION SKILL SCORES FOR 1978-1984
SKILL SCORE
20
15
10
5
0
-5
-10
-15
-20
-25
day 3 man
day 5 man
day 4 man
climatology
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Fig 47

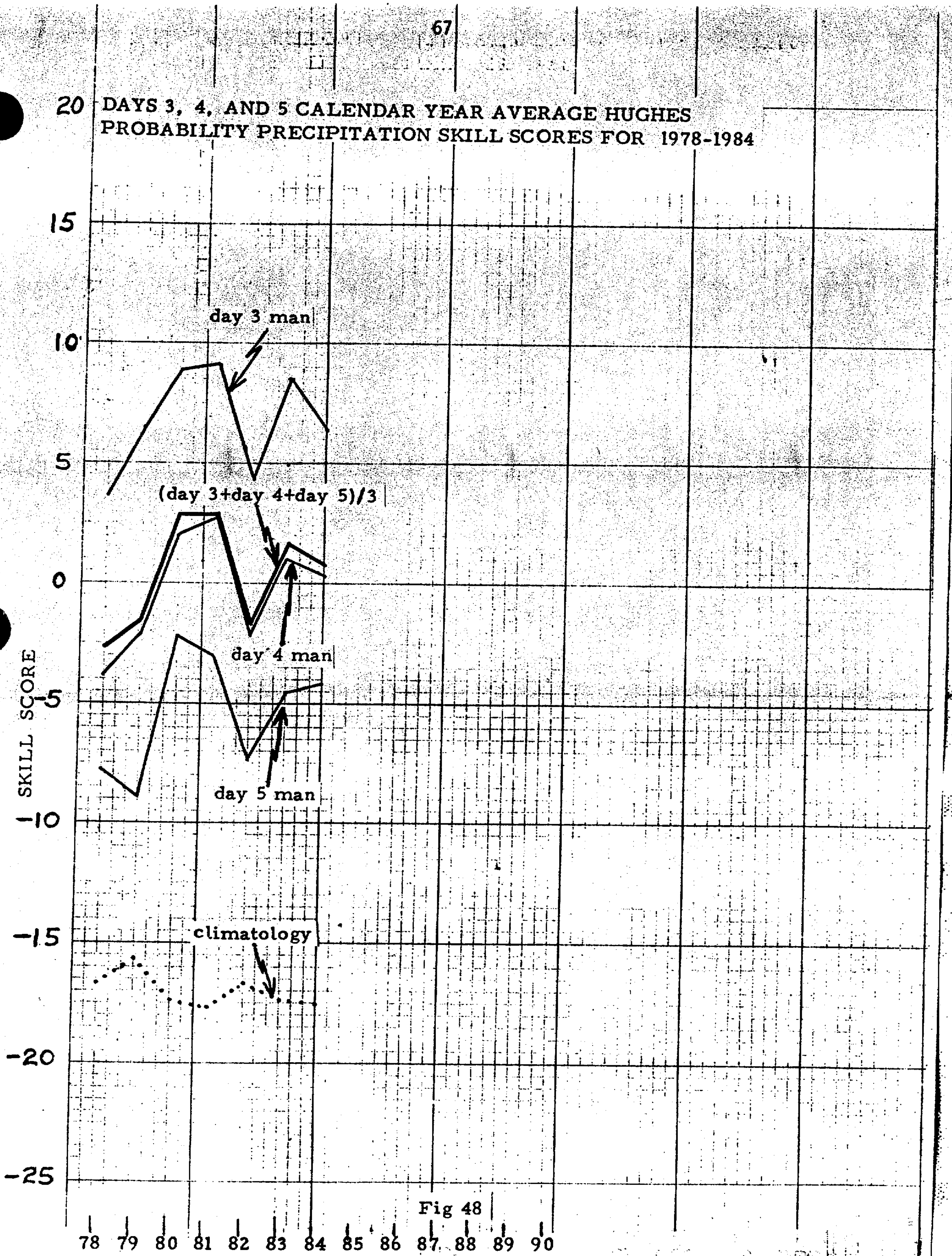

DAYS 3, 4, AND 5 CALENDAR YEAR AVERAGE HUGHES PROBABILITY PRECIPITATION SKILL SCORES FOR 1978-1984
20
15
10
5
0
-5
-10
-15
-20
-25
SKILL SCORE
day 3 man
(day 3+day 4+day 5)/3
day 4 man
day 5 man
climatology
78
79
80
81
82
83
84
85
86
87
88
89
90

Fig 48

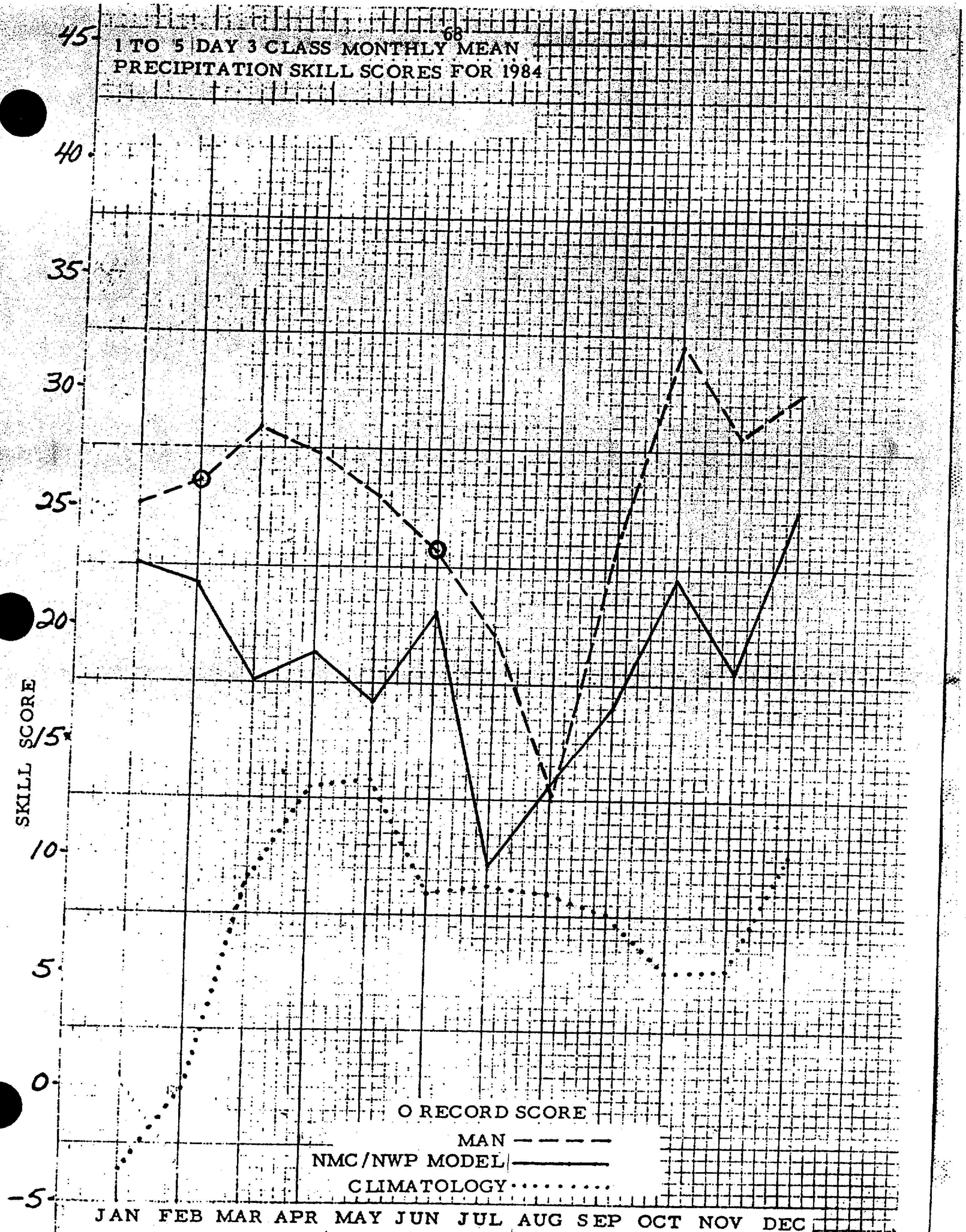

1 TO 5 DAY 3 CLASS MONTHLY MEAN
PRECIPITATION SKILL SCORES FOR 1984
SKILL SCORE
45
40
35
30
25
20
15
10
5
0
-5
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
O RECORD SCORE
MAN
NMC/NWP MODEL
CLIMATOLOGY

Fig 49

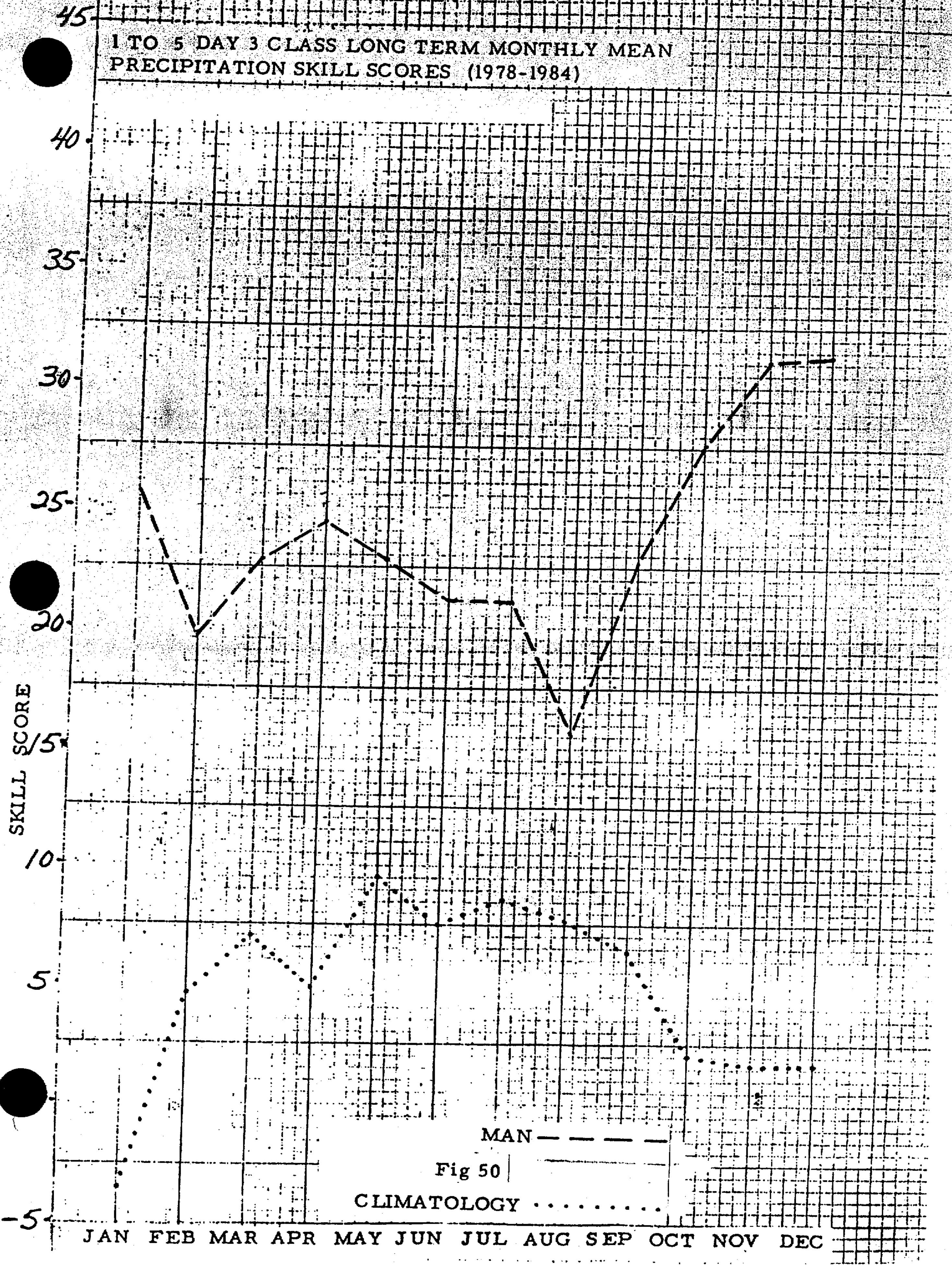
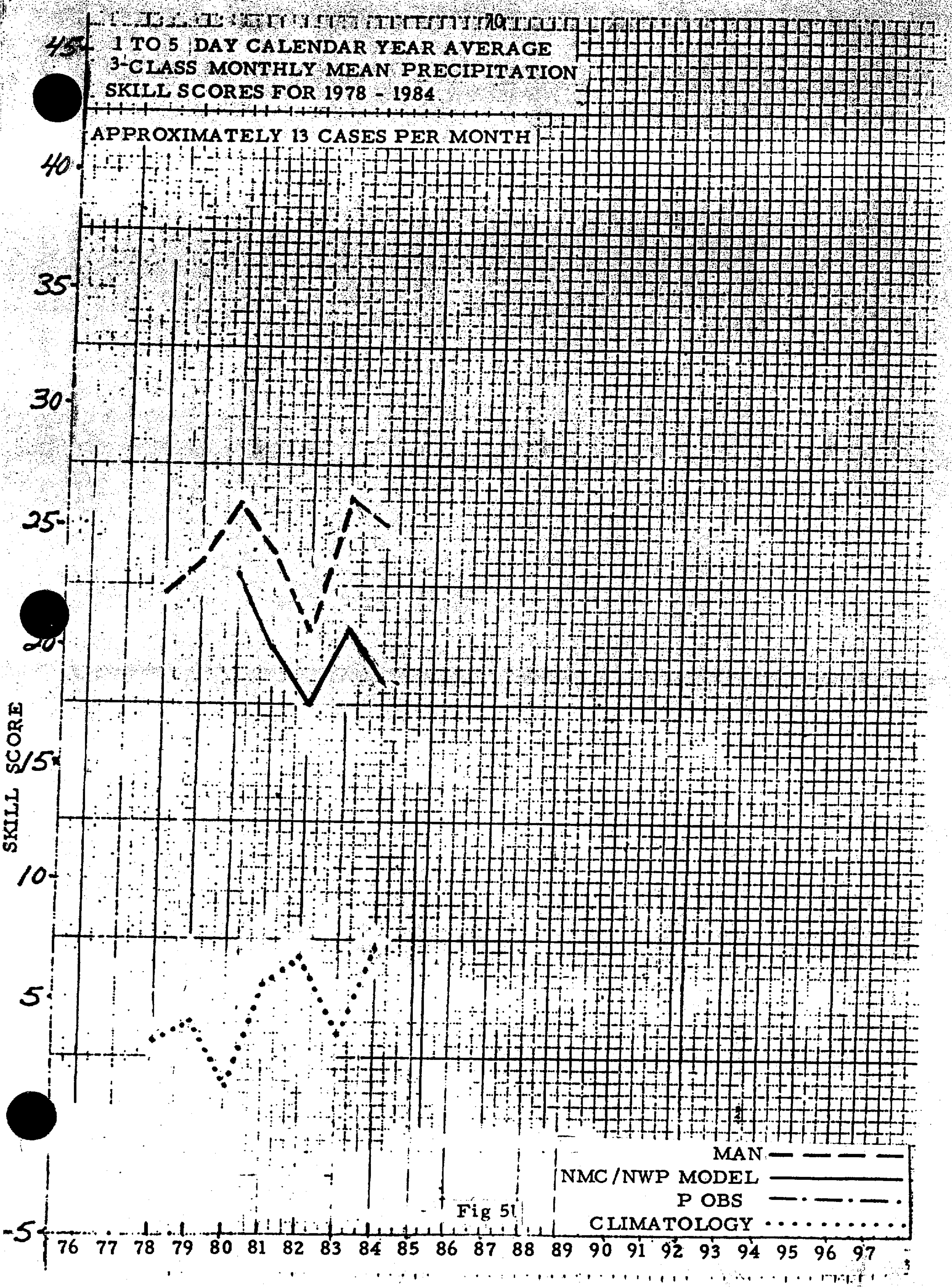
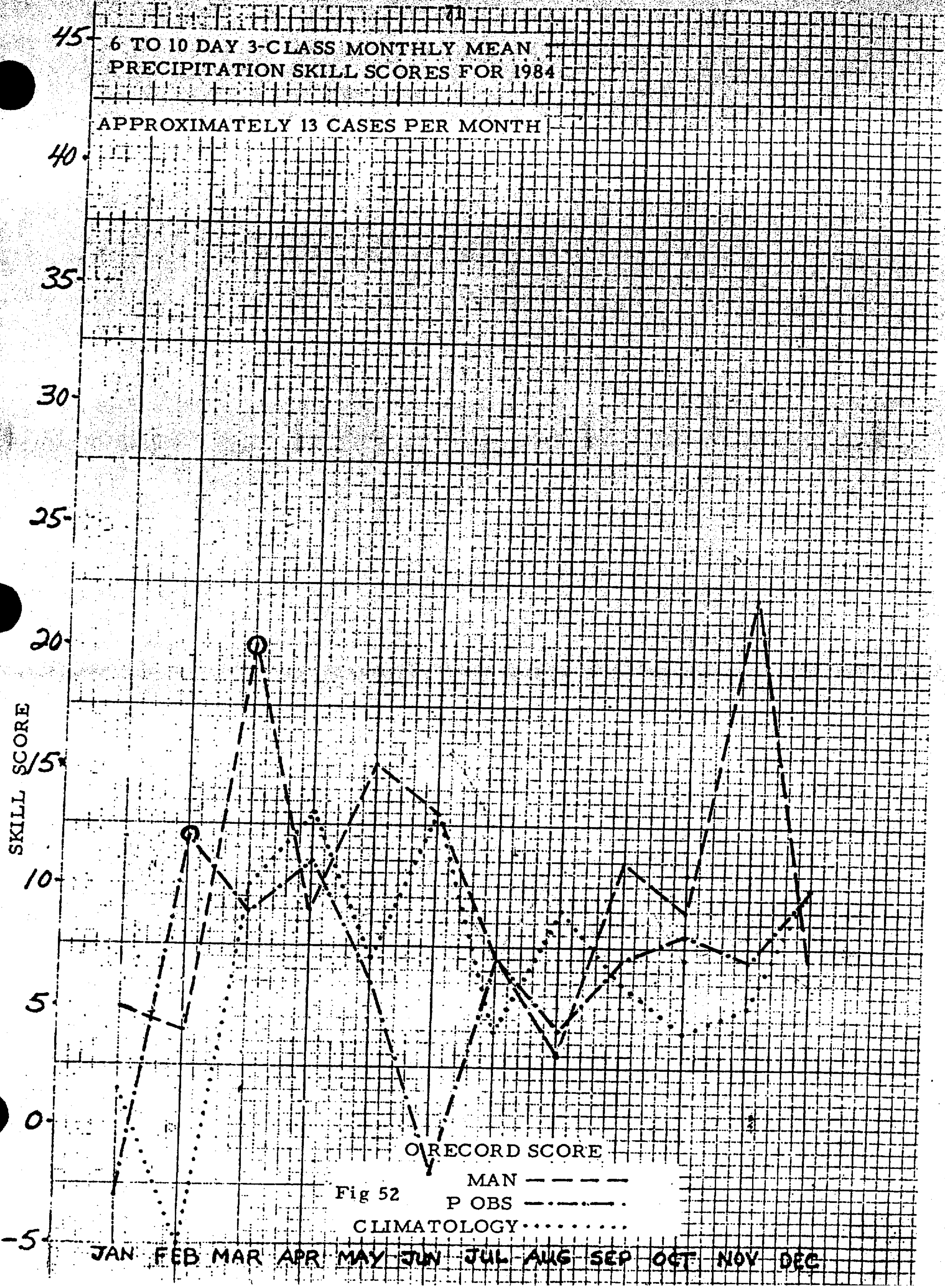

1 TO 5 DAY 3 CLASS LONG TERM MONTHLY MEAN
PRECIPITATION SKILL SCORES (1978-1984)
SKILL SCORE
45
40
35
30
25
20
15
10
5
-5
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MAN
CLIMATOLOGY

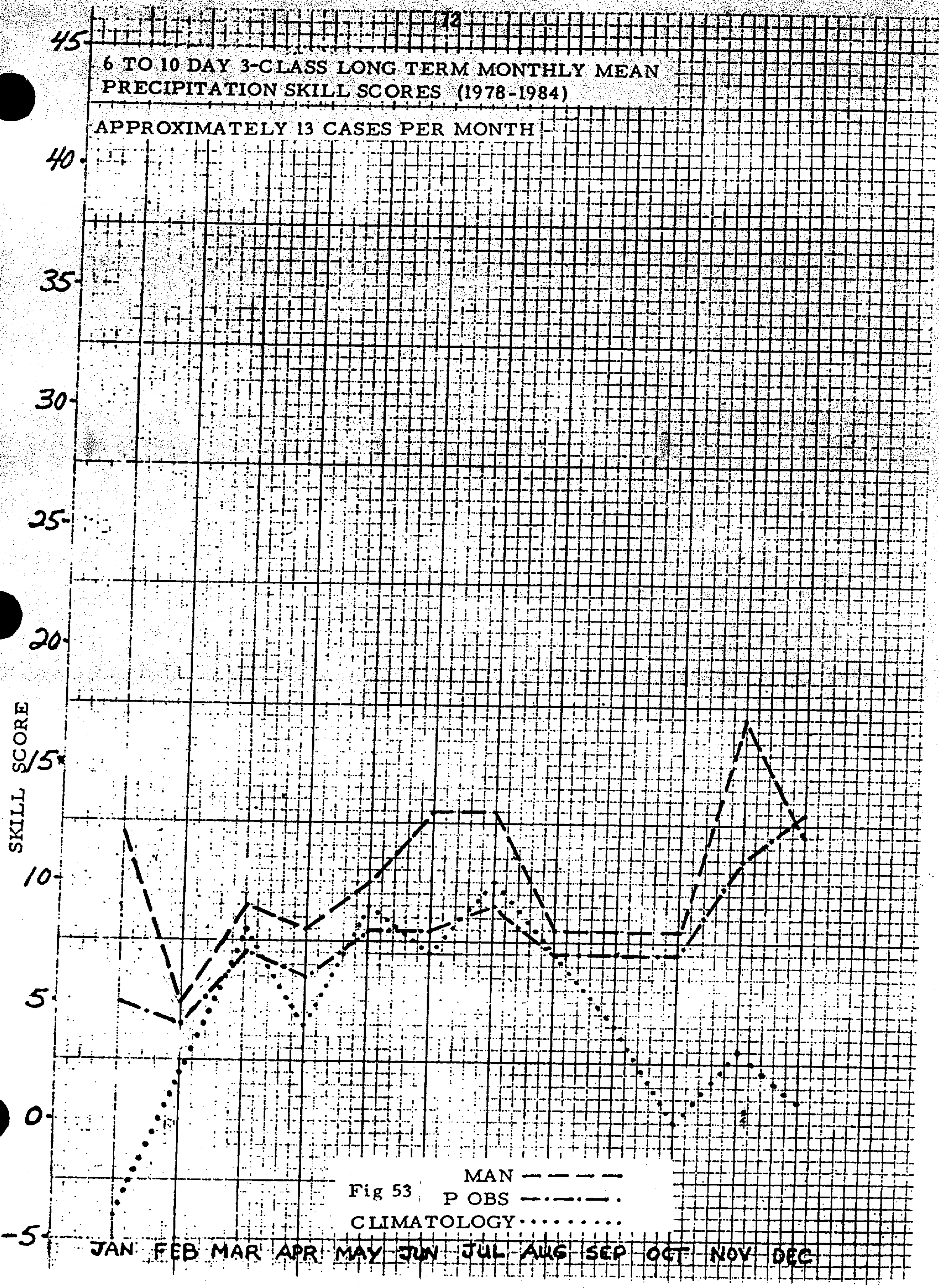
Fig 50



1 TO 5 DAY CALENDAR YEAR AVERAGE
3-CLASS MONTHLY MEAN PRECIPITATION
SKILL SCORES FOR 1978 - 1984
APPROXIMATELY 13 CASES PER MONTH
SKILL SCORE
45
40
35
30
25
20
15
10
5
-5
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97
MAN
NMC/NWP MODEL
P OBS
CLIMATOLOGY

Fig 51


71
6 TO 10 DAY 3-CLASS MONTHLY MEAN
PRECIPITATION SKILL SCORES FOR 1984
APPROXIMATELY 13 CASES PER MONTH
SKILL SCORE
45
40
35
30
25
20
15
10
5
0
-5
O RECORD SCORE
MAN
P OBS
CLIMATOLOGY
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Fig 52



72
6 TO 10 DAY 3-CLASS LONG TERM MONTHLY MEAN
PRECIPITATION SKILL SCORES (1978-1984)
APPROXIMATELY 13 CASES PER MONTH
SKILL SCORE
45
40
35
30
25
20
15
10
5
0
-5
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MAN
P OBS
CLIMATOLOGY

Fig 53

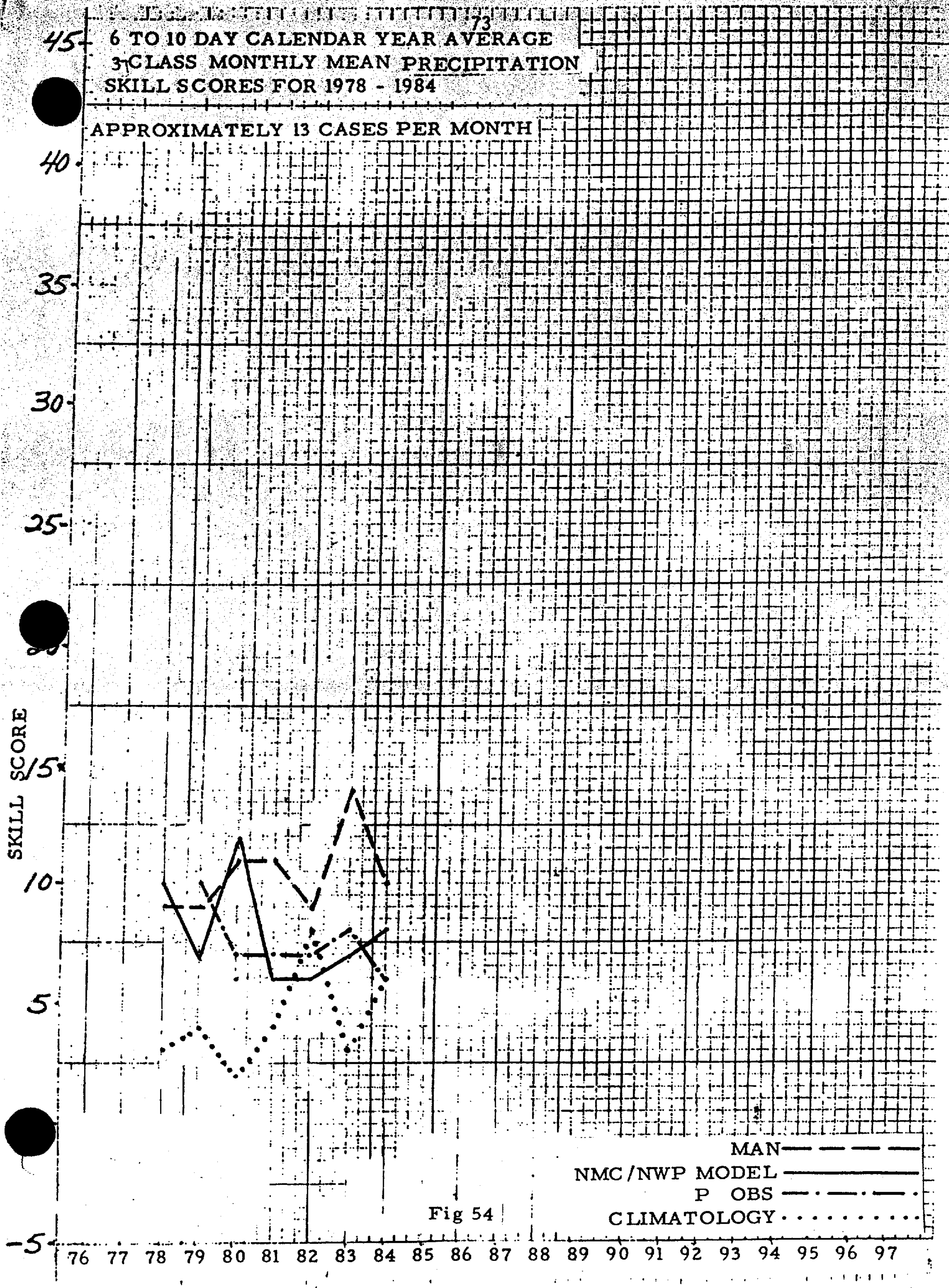

6 TO 10 DAY CALENDAR YEAR AVERAGE
3-CLASS MONTHLY MEAN PRECIPITATION
SKILL SCORES FOR 1978 - 1984
APPROXIMATELY 13 CASES PER MONTH
SKILL SCORE
45
40
35
30
25
15
10
5
-5
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97
MAN
NMC/NWP MODEL
P OBS
CLIMATOLOGY

Fig 54

SECTION 4

Man & Machine (NMC/NWP Guidance)

Days 1 through 7 Monthly Mean Sea Level Pressure, 500 MB and Absolute Error Temperature Scores

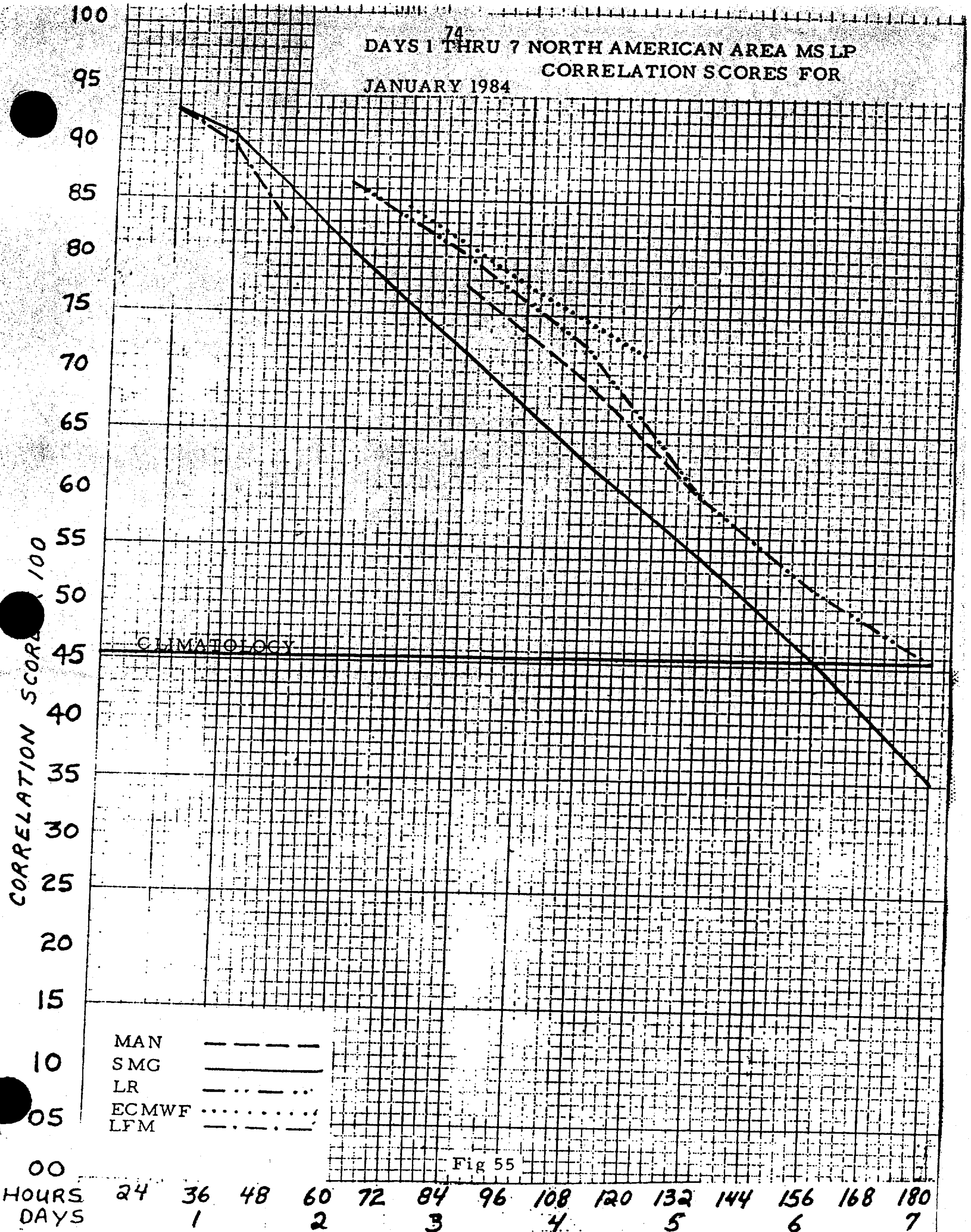

DAYS 1 THRU 7 NORTH AMERICAN AREA MS LP
CORRELATION SCORES FOR
JANUARY 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
CLIMATOLOGY
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180
DAYS 1 2 3 4 5 6 7
MAN
SMG
LR
ECMWF
LFM

Fig 55

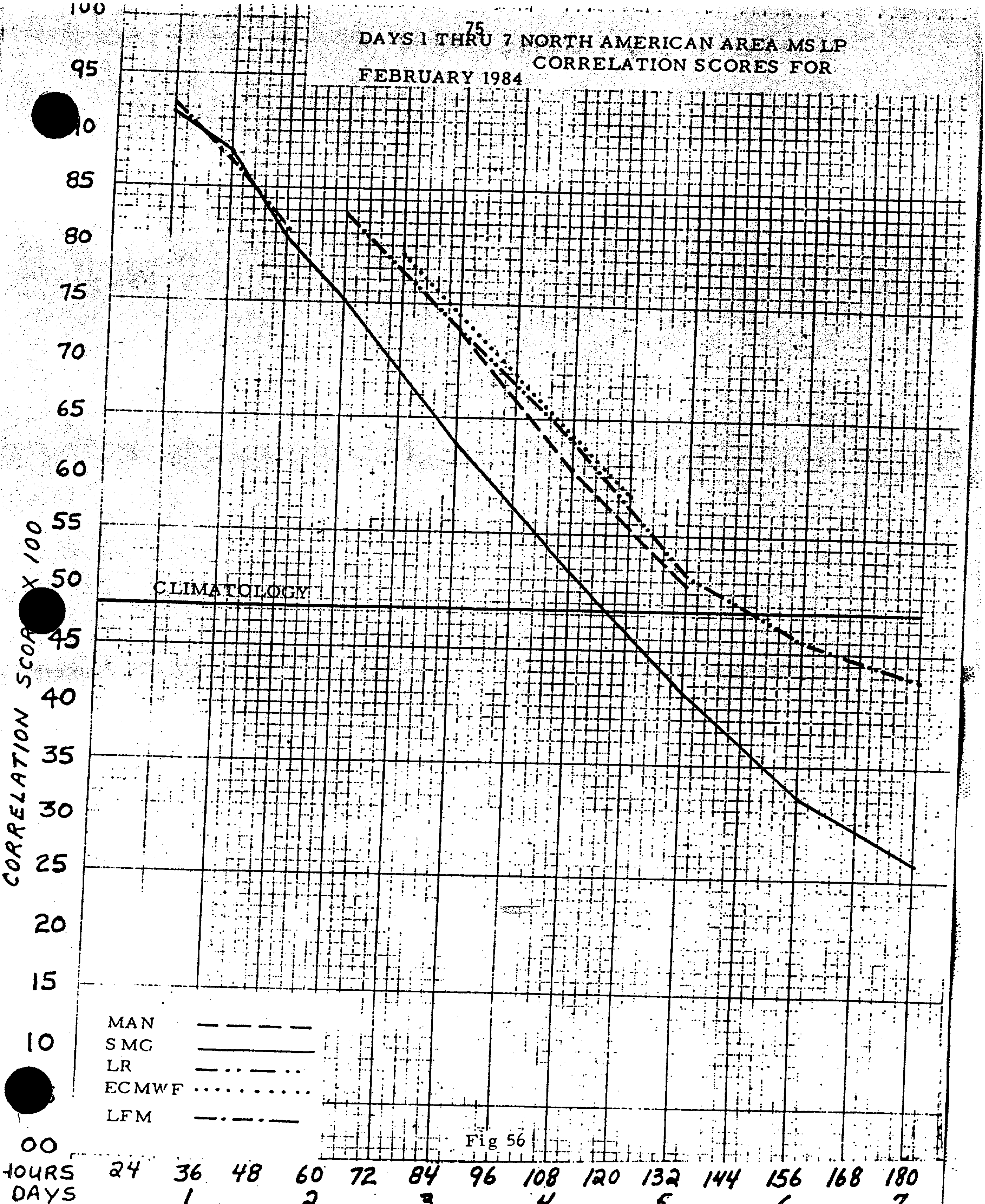

DAYS 1 THRU 7 NORTH AMERICAN AREA MSLP CORRELATION SCORES FOR FEBRUARY 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
00
CLIMATOLOGY
MAN
SMG
LR
ECMWF
LFM
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
DAYS
1
2
3
4
5
6
7

Fig 56

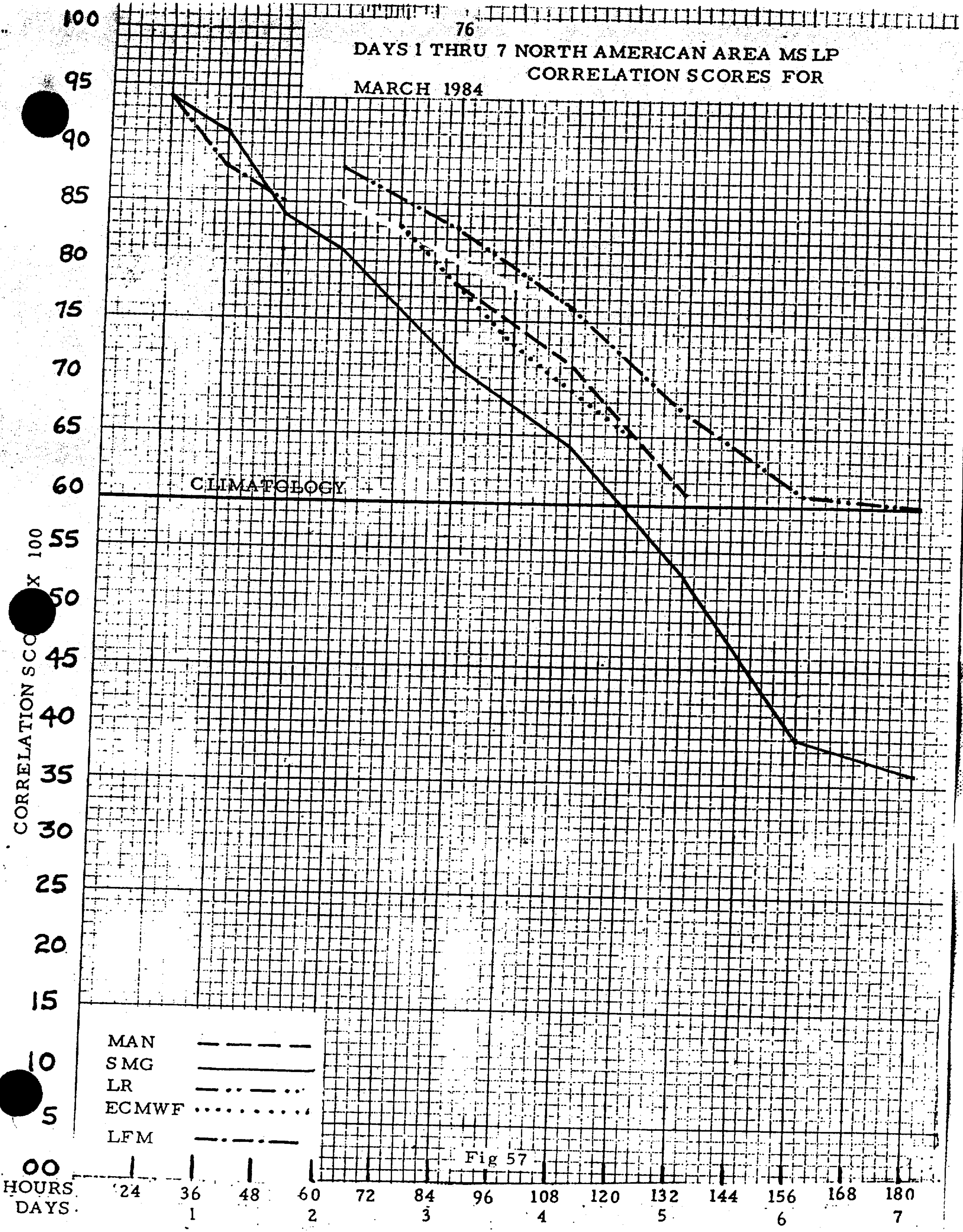

DAYS 1 THRU 7 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR
MARCH 1984
CORRELATION SCORES X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
CLIMATOLOGY
MAN
SMG
LR
ECMWF
LFM
HOURS
DAYS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
1
2
3
4
5
6
7

Fig 57

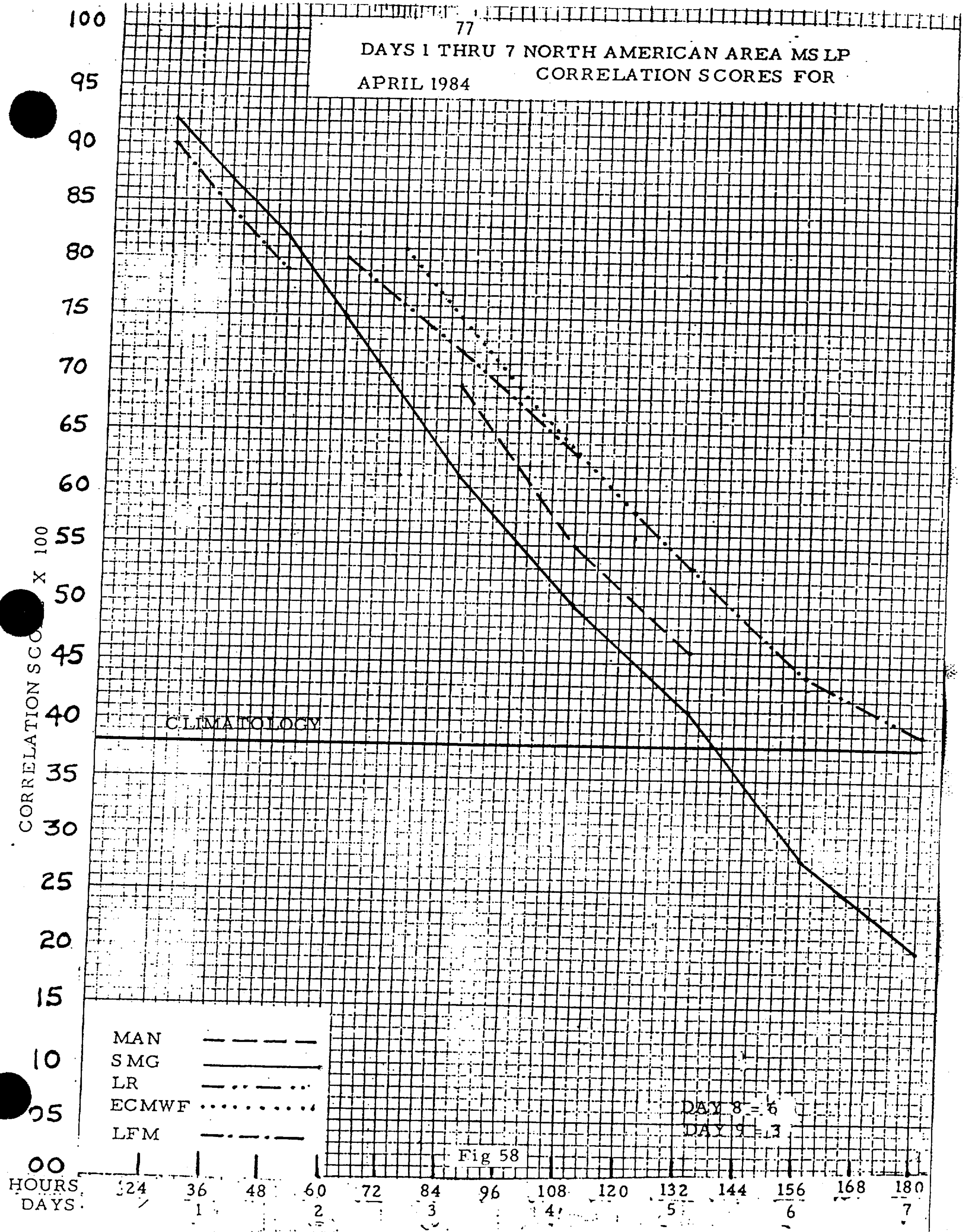

DAYS 1 THRU 7 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR
APRIL 1984
CORRELATION SCORE X 100
CLIMATOLOGY
MAN
SMG
LR
ECMWF
LFM
DAY 8 = 6
DAY 9 = 3
HOURS
DAYS
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
24
36
48
60
72
84
96
108
120
132
144
156
168
180
1
2
3
4
5
6
7

Fig 58

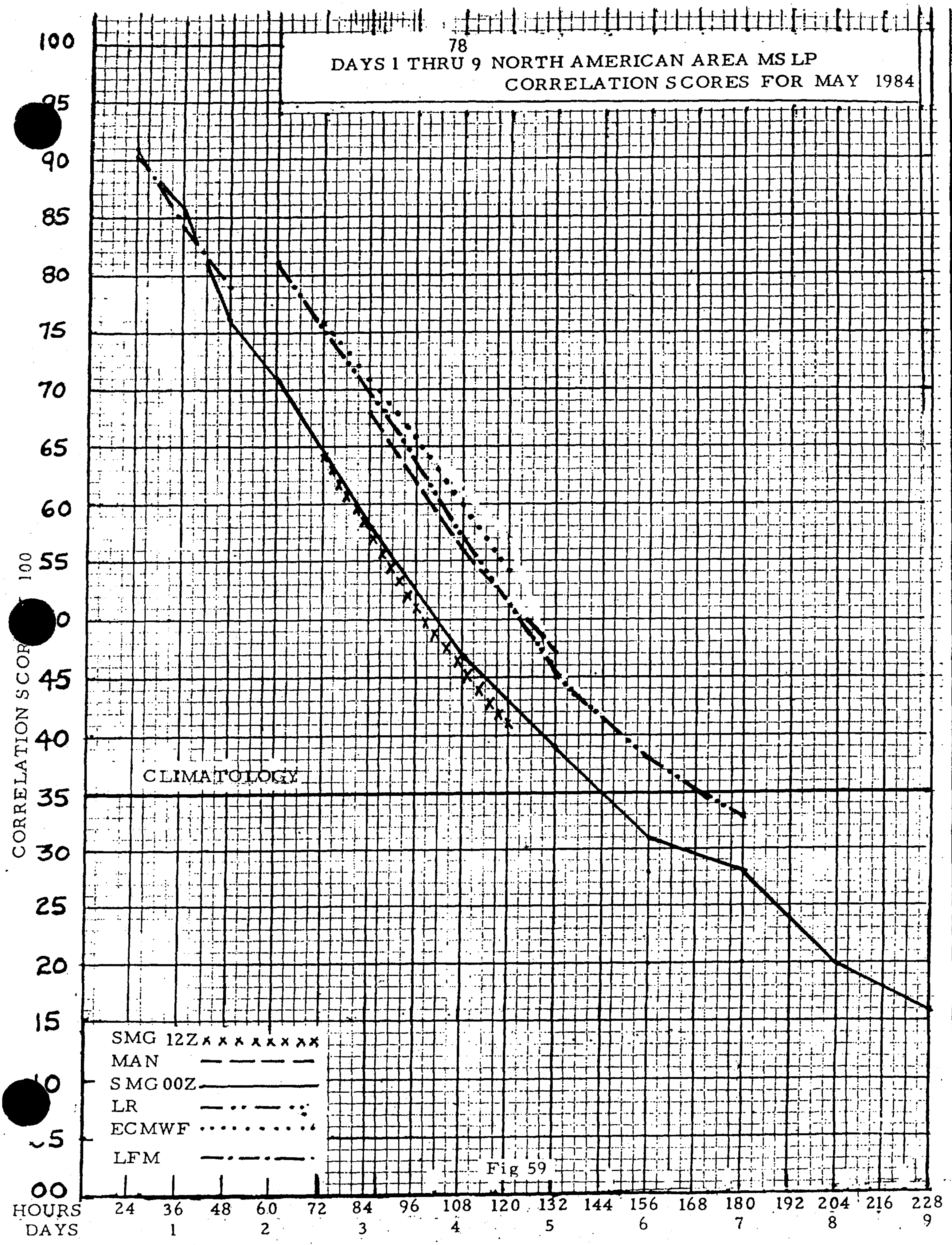

DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
CORRELATION SCORES FOR MAY 1984
CORRELATION SCORE 100
CLIMATOLOGY
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 00

Fig 59

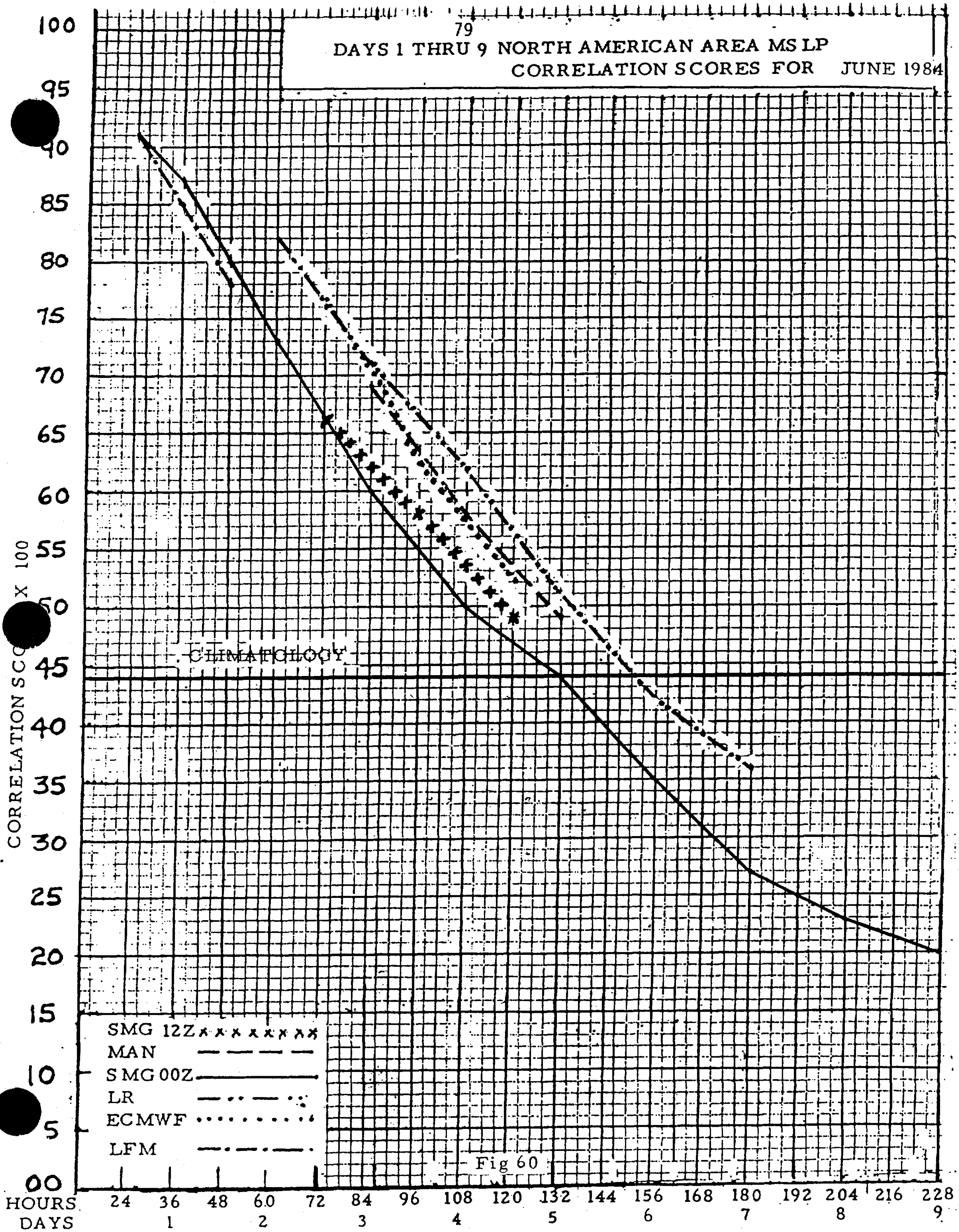
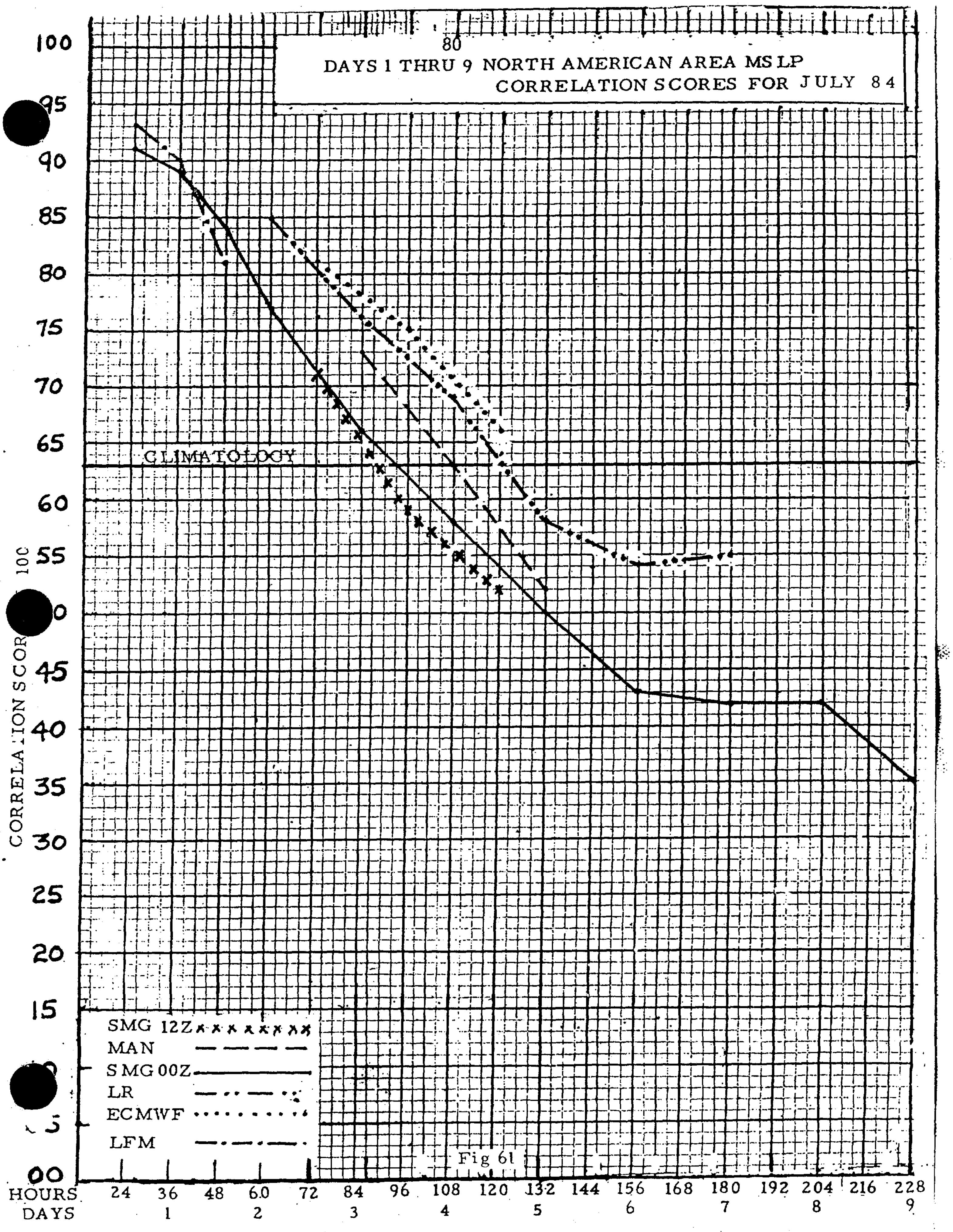
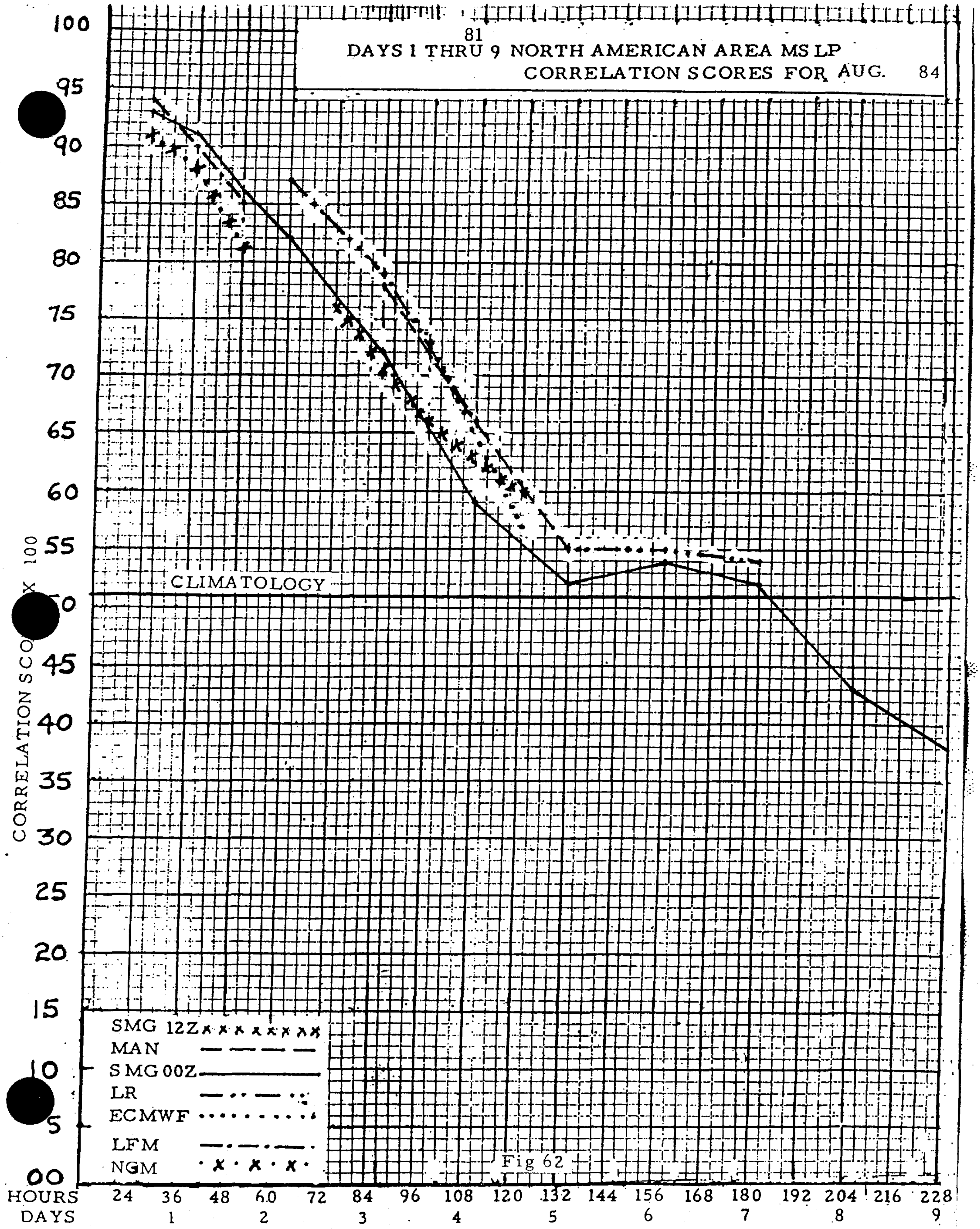

DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR JUNE 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
CLIMATOLOGY
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
DAYS
1
2
3
4
5
6
7
8
9

Fig 60


80
DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR JULY 84
CLIMATOLOGY
CORRELATION SCORE 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
Fig 61


81
DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
CORRELATION SCORES FOR AUG. 84
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
CLIMATOLOGY
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
Fig 62

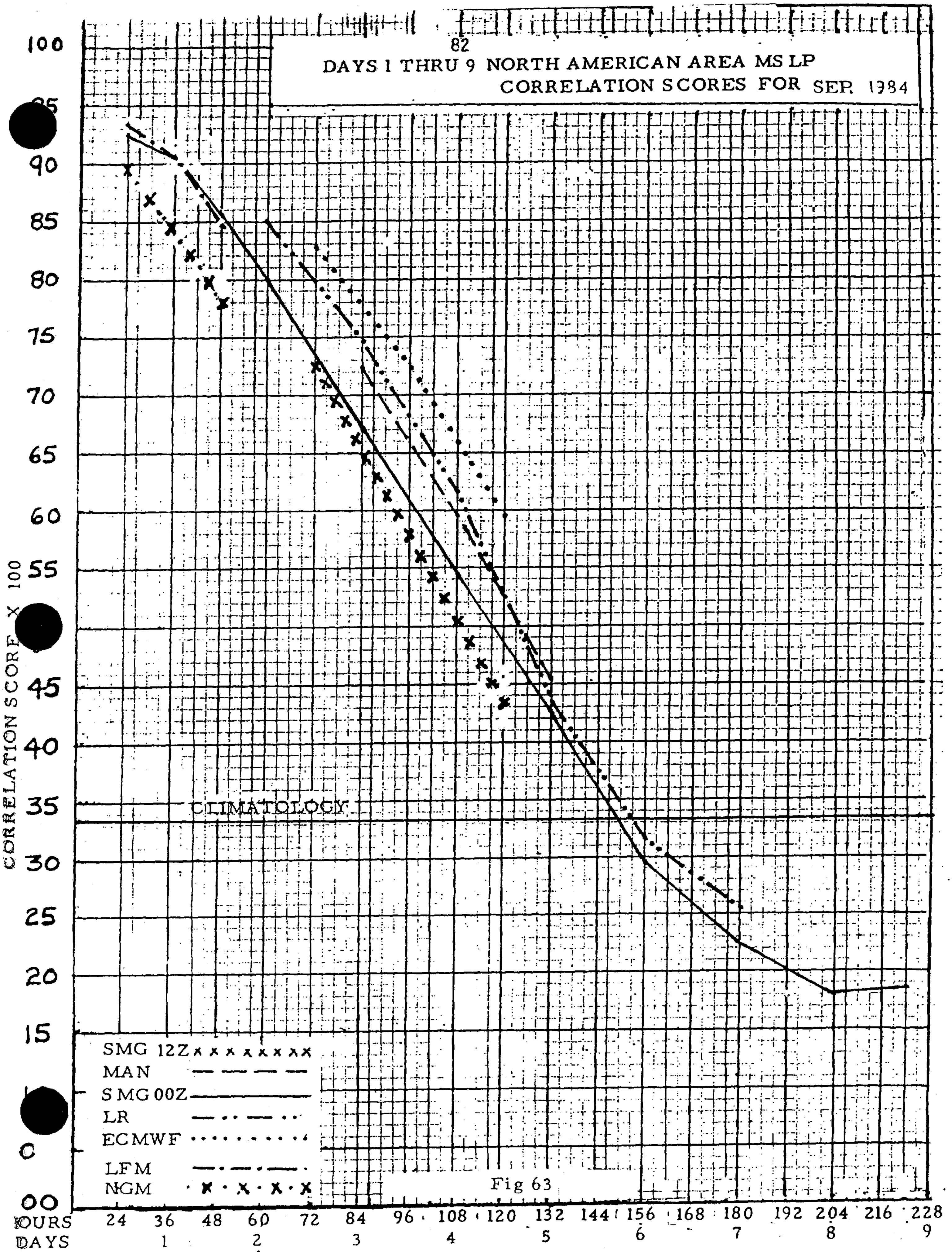

DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
CORRELATION SCORES FOR SEP. 1984
CORRELATION SCORE X 100
CLIMATOLOGY
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9

Fig 63

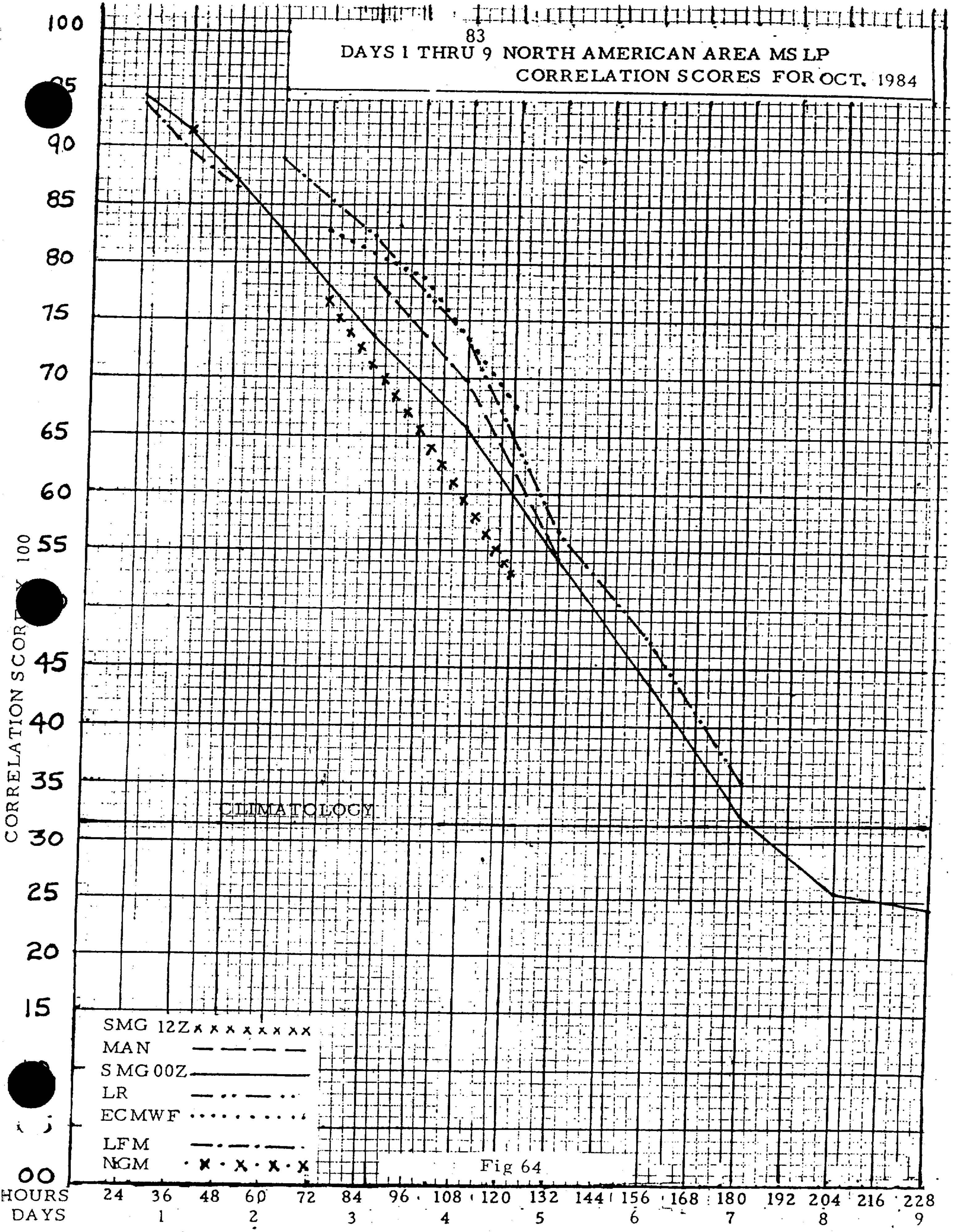

DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR OCT. 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
00
CLIMATOLOGY
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
DAYS
1
2
3
4
5
6
7
8
9

Fig 64

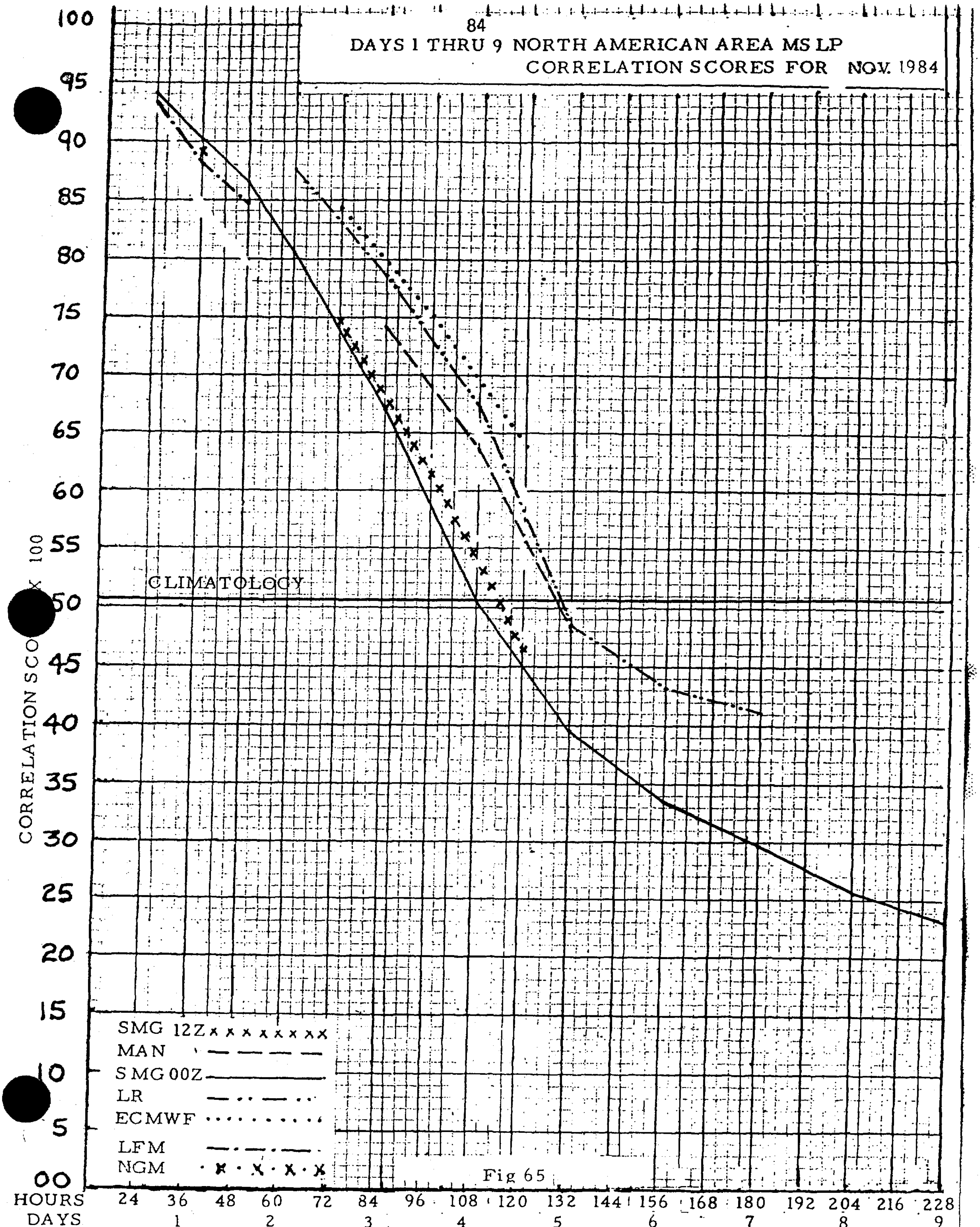

DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
CORRELATION SCORES FOR NOV. 1984
CORRELATION SCORE X 100
CLIMATOLOGY
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM

Fig 65

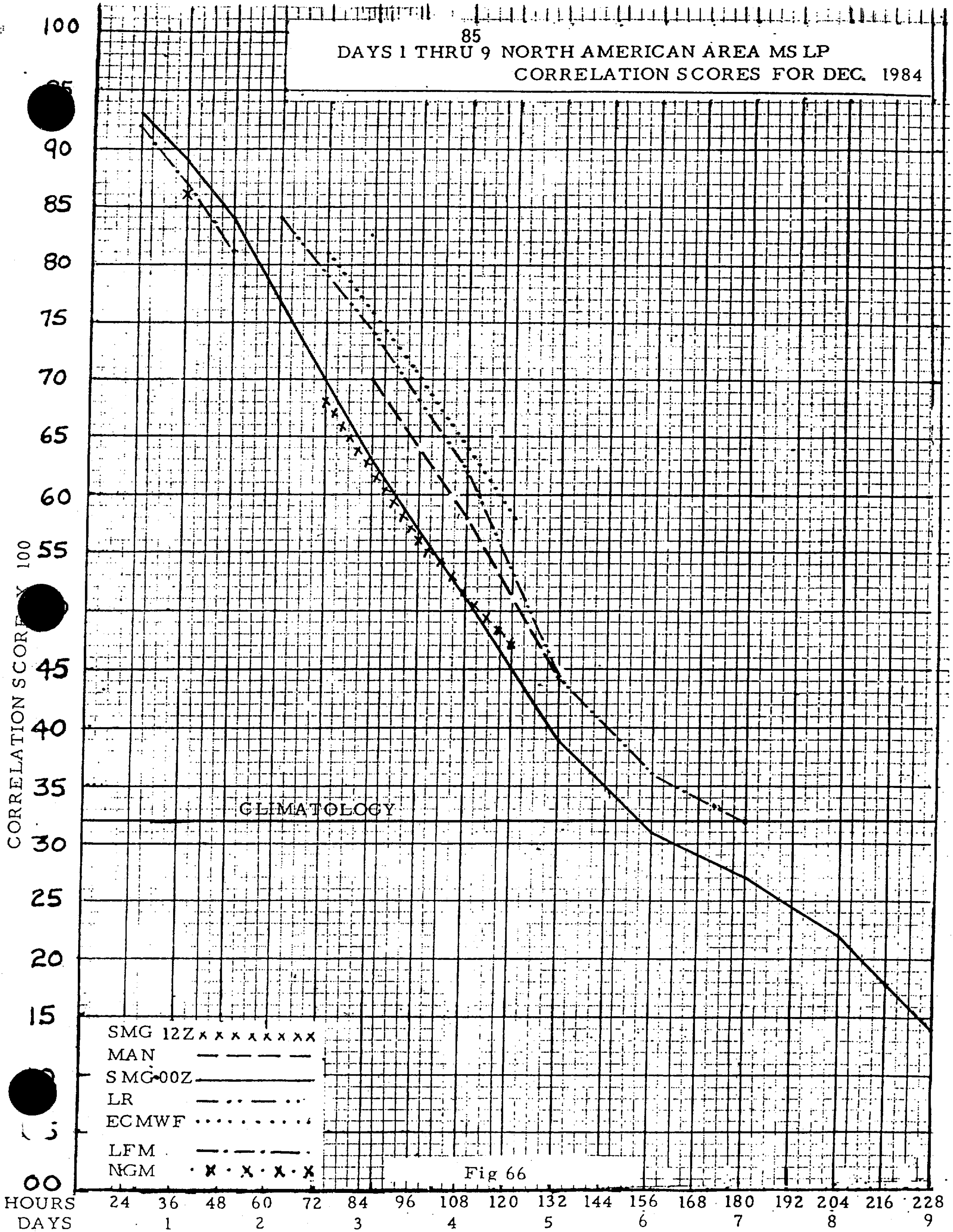

DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
CORRELATION SCORES FOR DEC. 1984
CORRELATION SCORE X 100
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
00
CLIMATOLOGY
SMG 12Z
MAN
SMG-00Z
LR
ECMWF
LFM
NGM
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
DAYS
1
2
3
4
5
6
7
8
9

Fig 66

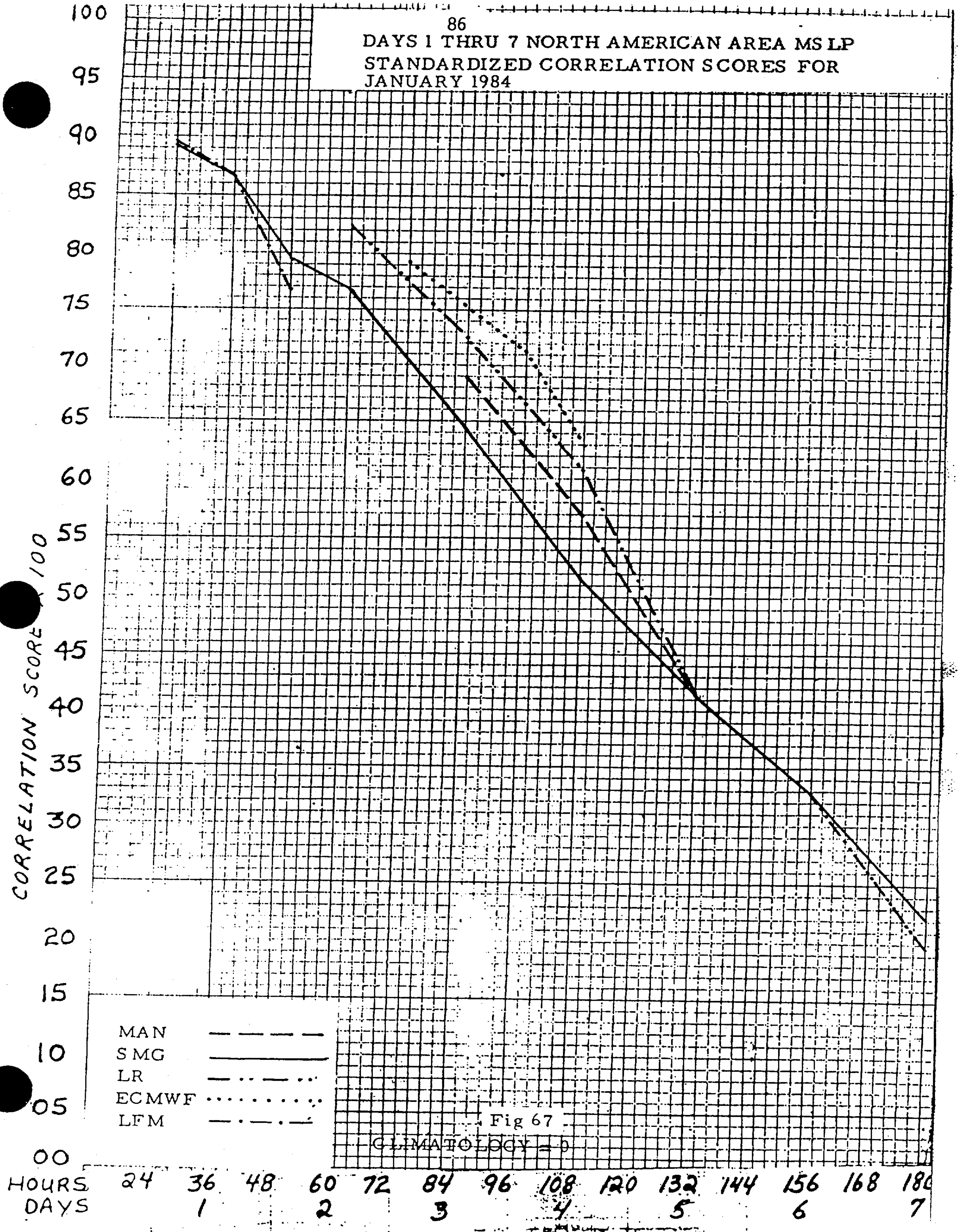

DAYS 1 THRU 7 NORTH AMERICAN AREA MS LP
STANDARDIZED CORRELATION SCORES FOR
JANUARY 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
MAN
SMG
LR
ECMWF
LFM
CLIMATOLOGY = 0
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180
DAYS 1 2 3 4 5 6 7

Fig 67

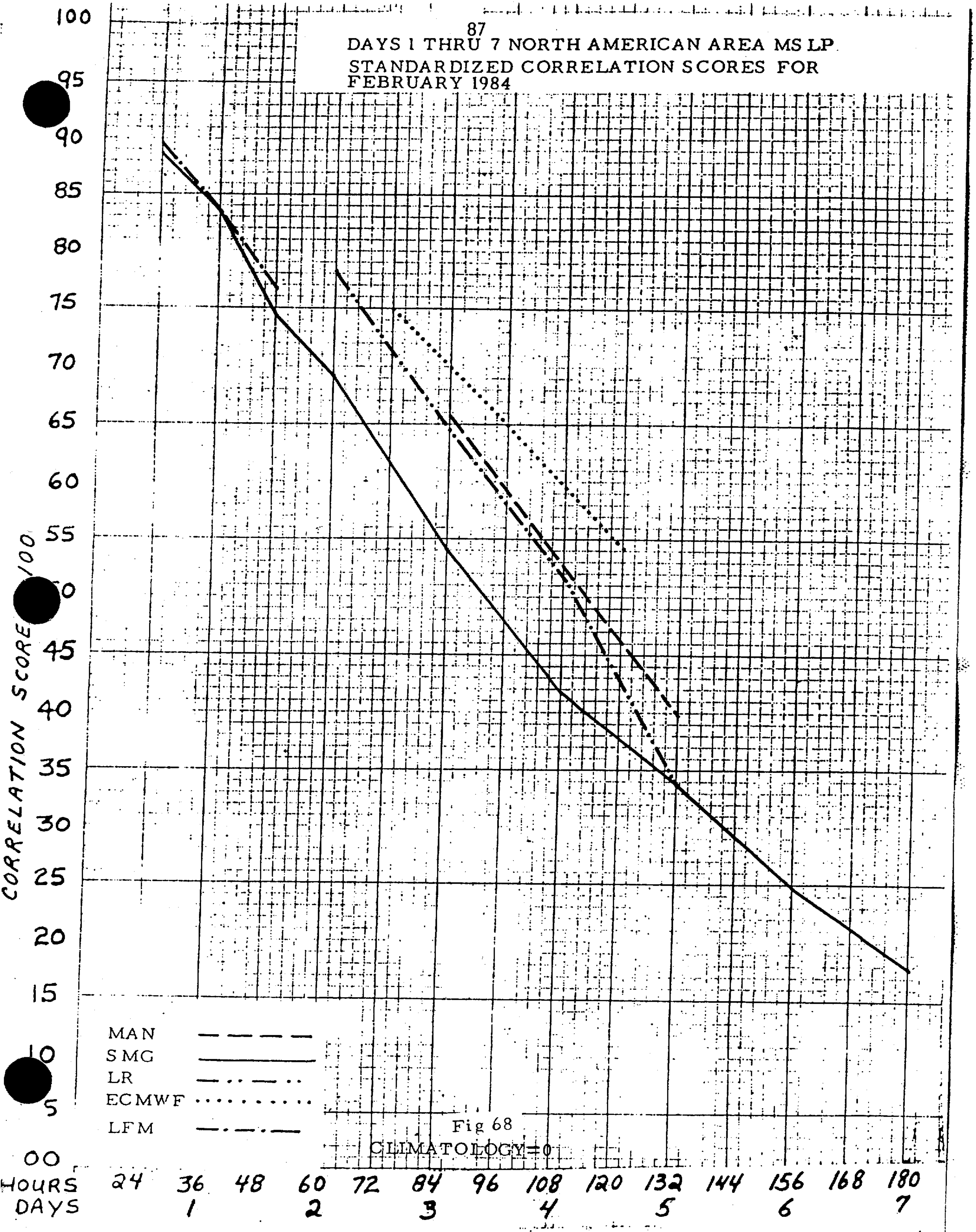
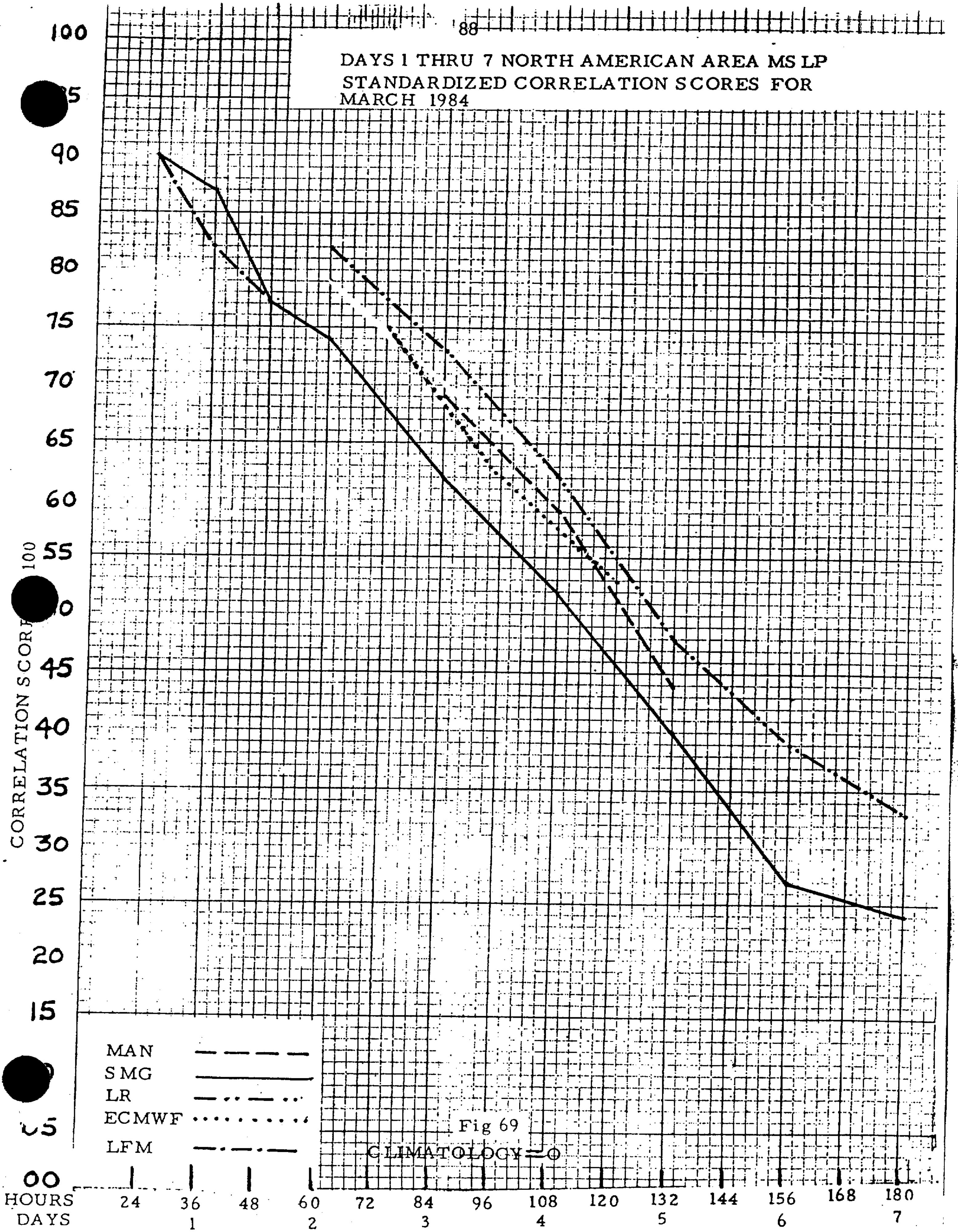

DAYS 1 THRU 7 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR FEBRUARY 1984
CORRELATION SCORE/100
100
95
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
5
00
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
DAYS
1
2
3
4
5
6
7
MAN
SMG
LR
ECMWF
LFM
CLIMATOLOGY=0

Fig 68


DAYS 1 THRU 7 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR
MARCH 1984
CORRELATION SCORE x 100
100
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
00
MAN
SMG
LR
ECMWF
LFM
CLIMATOLOGY = 0
HOURS
DAYS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
1
2
3
4
5
6
7
Fig 69

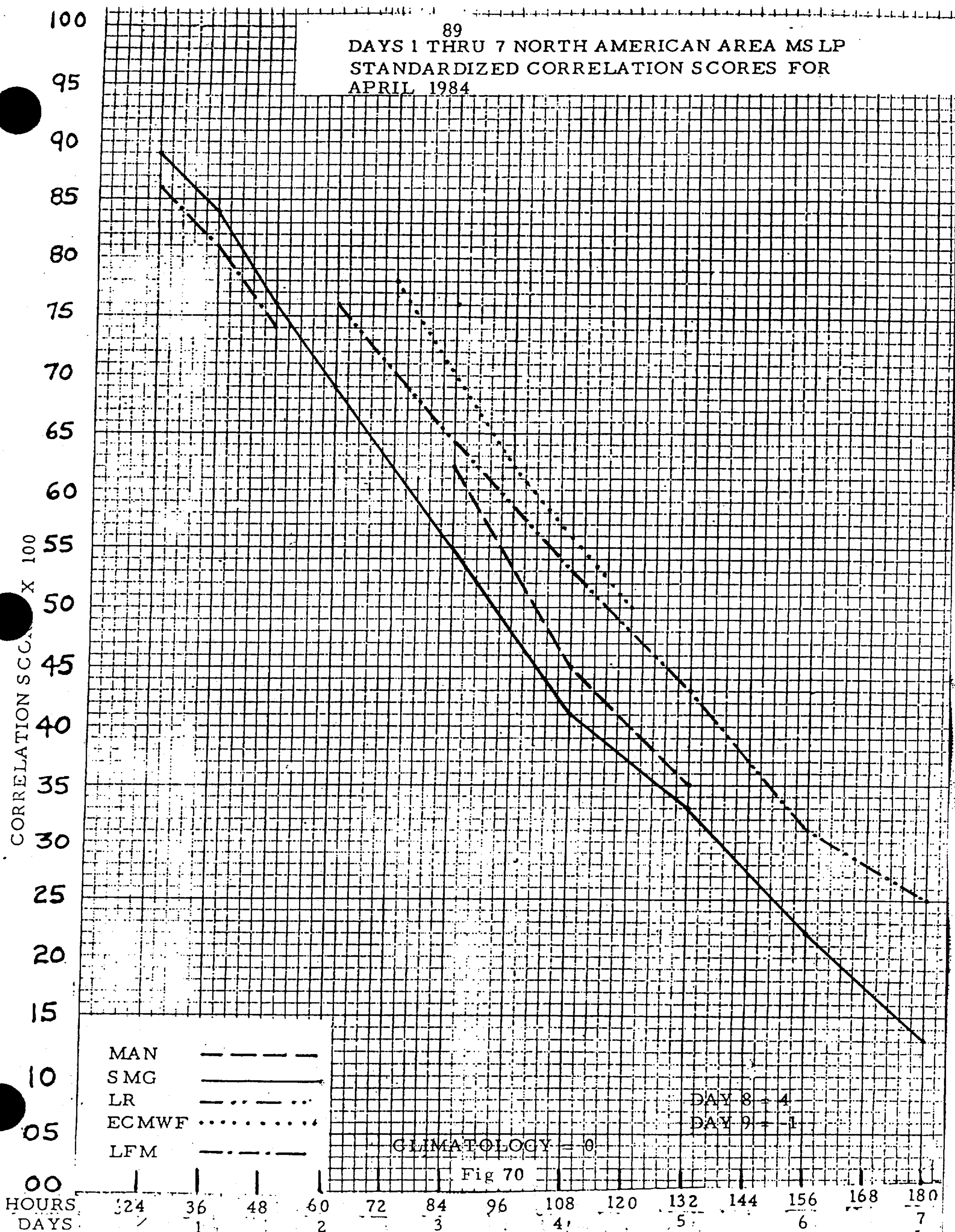
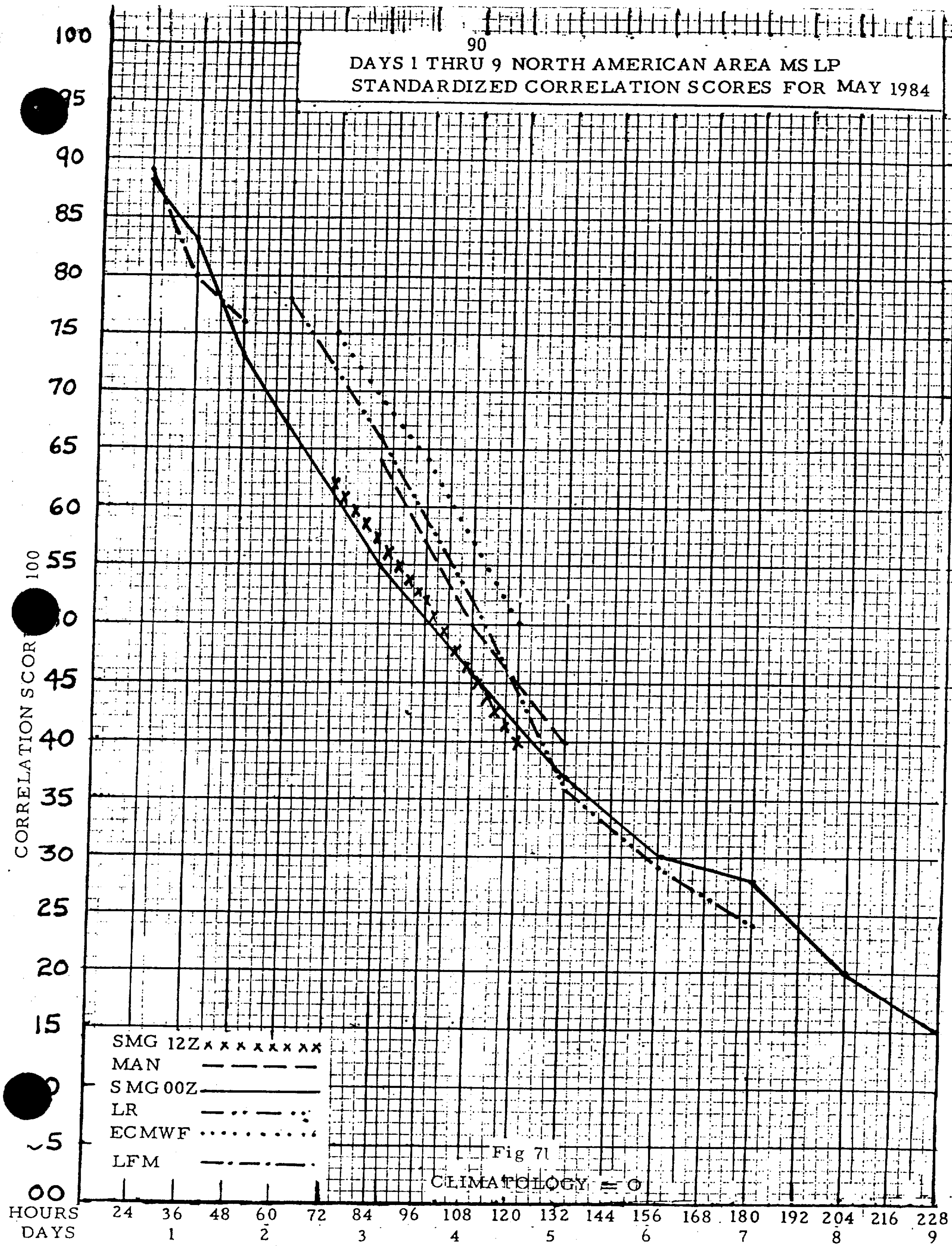
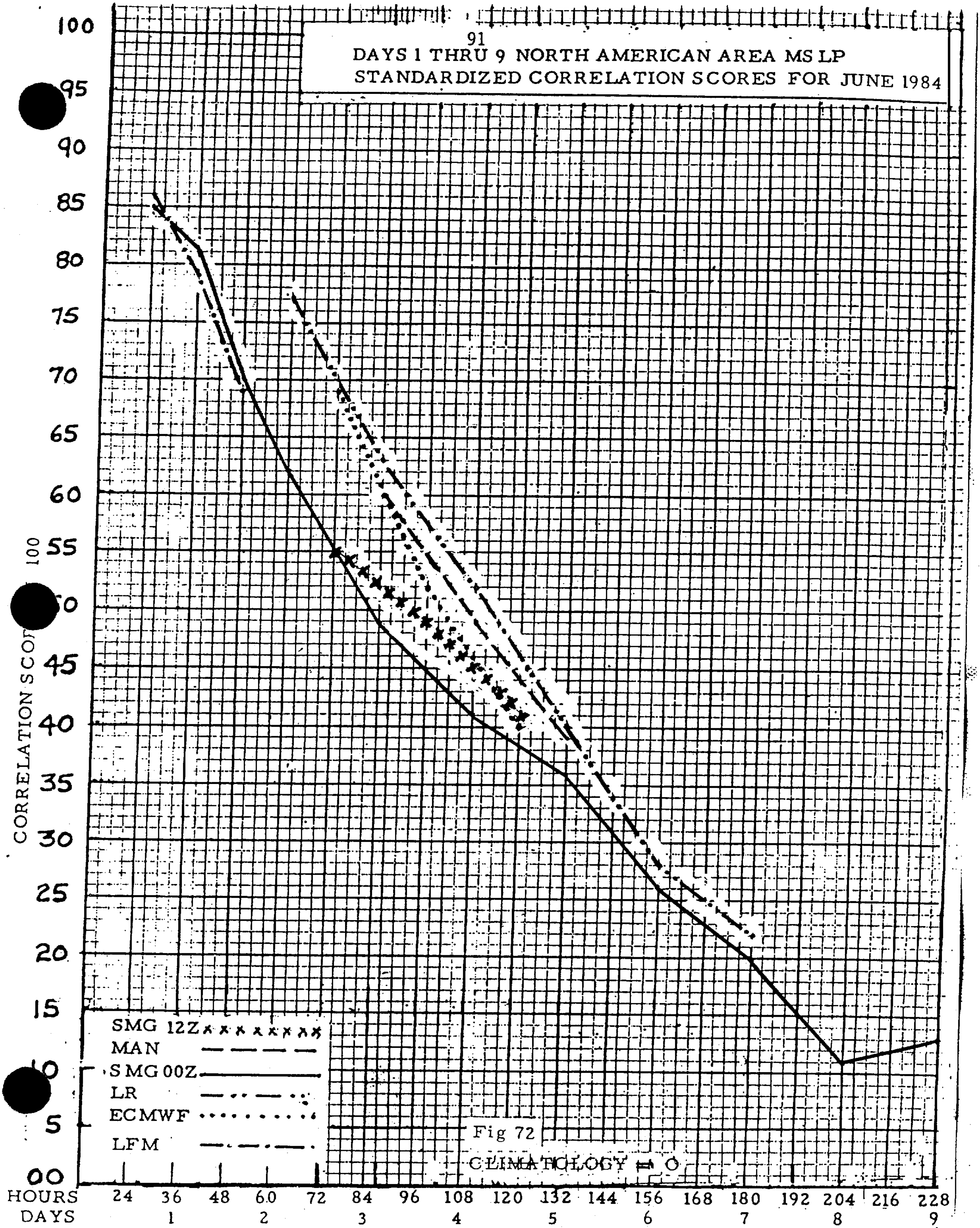

DAYS 1 THRU 7 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR
APRIL 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
MAN
SMG
LR
ECMWF
LFM
DAY 8 = 4
DAY 9 = -1
CLIMATOLOGY = 0
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180
DAYS 1 2 3 4 5 6 7

Fig 70



90
DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
STANDARDIZED CORRELATION SCORES FOR MAY 1984
CORRELATION SCORE
100
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
CLIMATOLOGY = 0

Fig 71


DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
STANDARDIZED CORRELATION SCORES FOR JUNE 1984
CORRELATION SCORE 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
CLIMATOLOGY = O
Fig 72

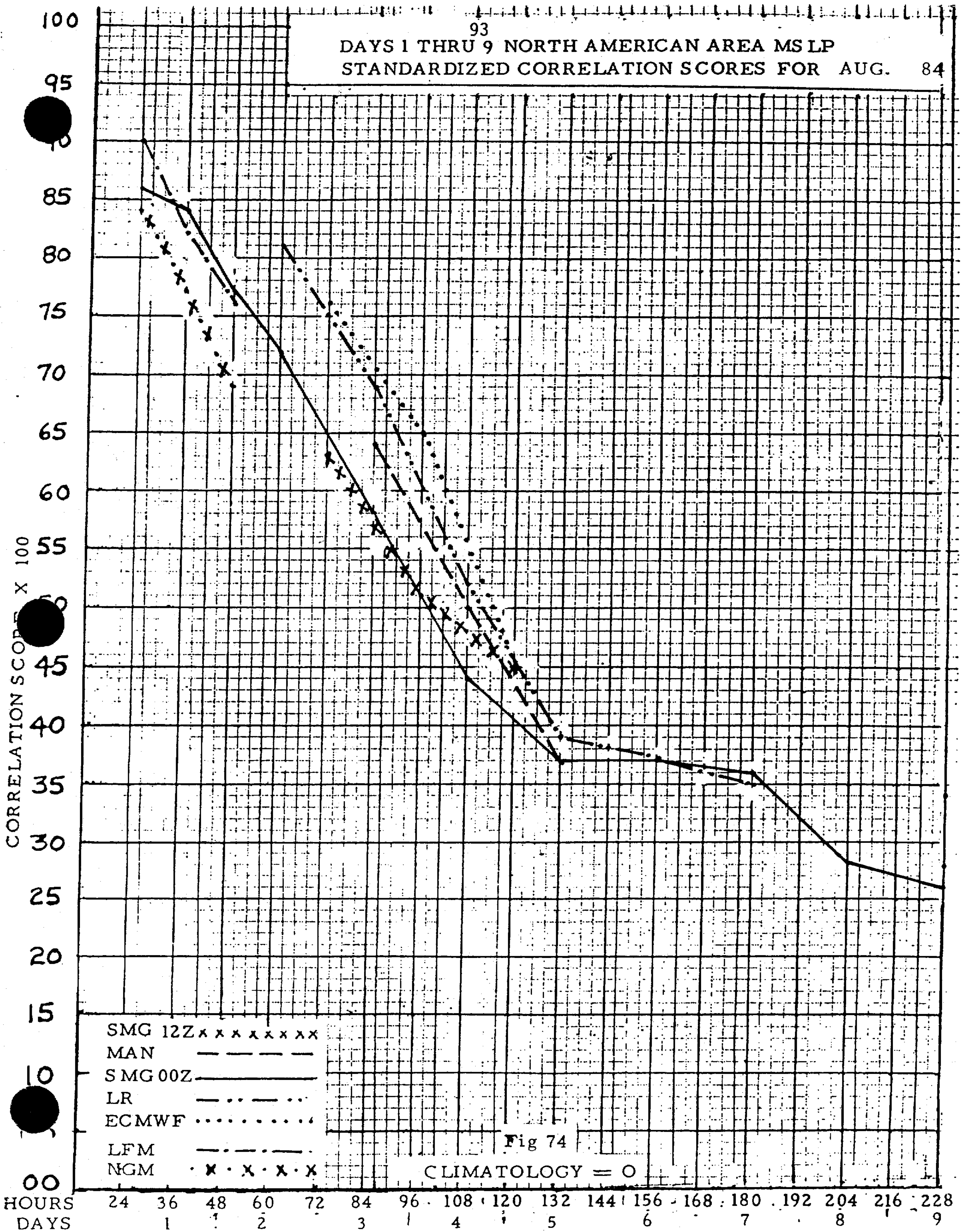

DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR AUG. 84
CORRELATION SCORE X 100
100
95
85
80
75
70
65
60
55
45
40
35
30
25
20
15
10
00
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
DAYS
1
2
3
4
5
6
7
8
9
SMG 12Z x x x x x x x x
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O

Fig 74

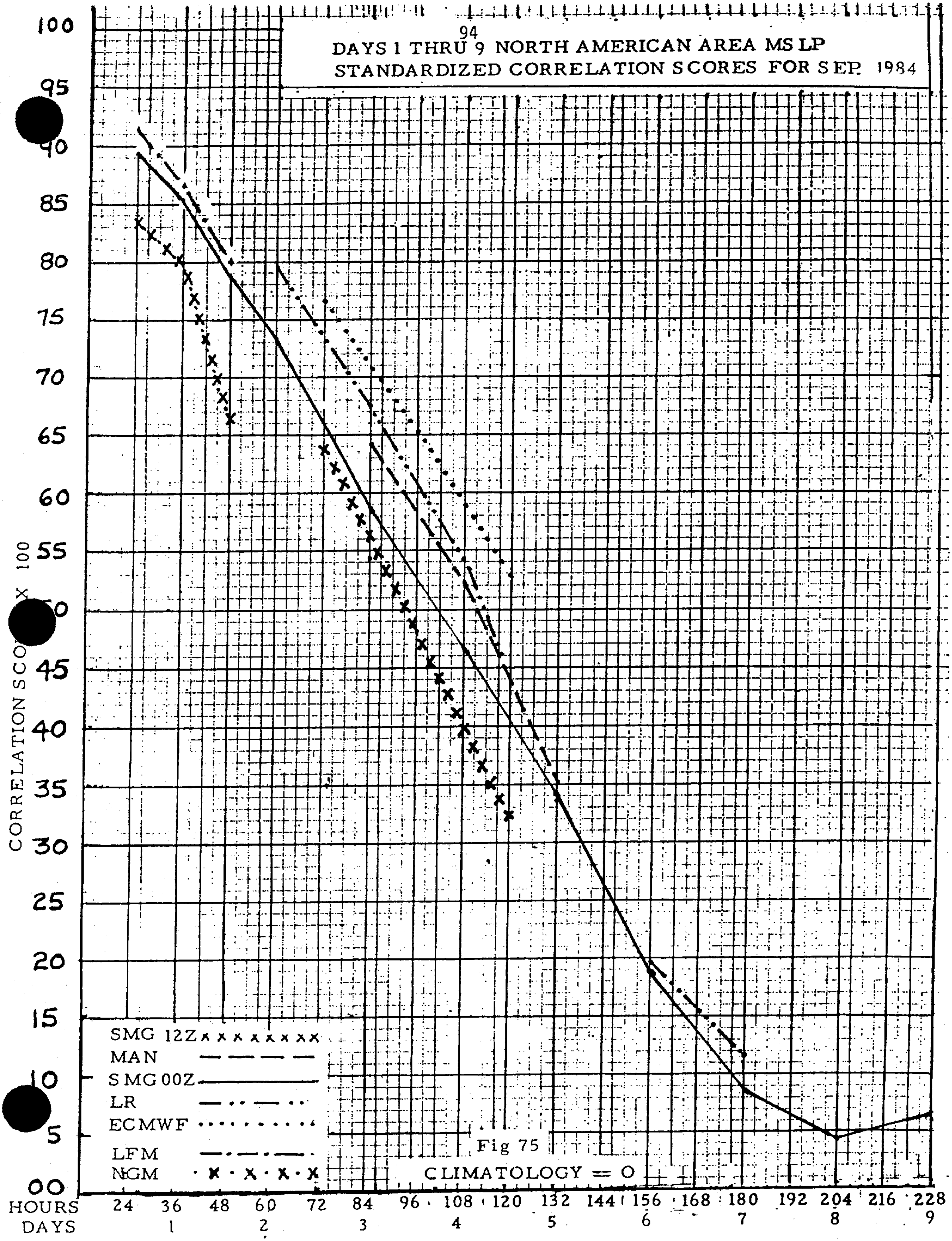
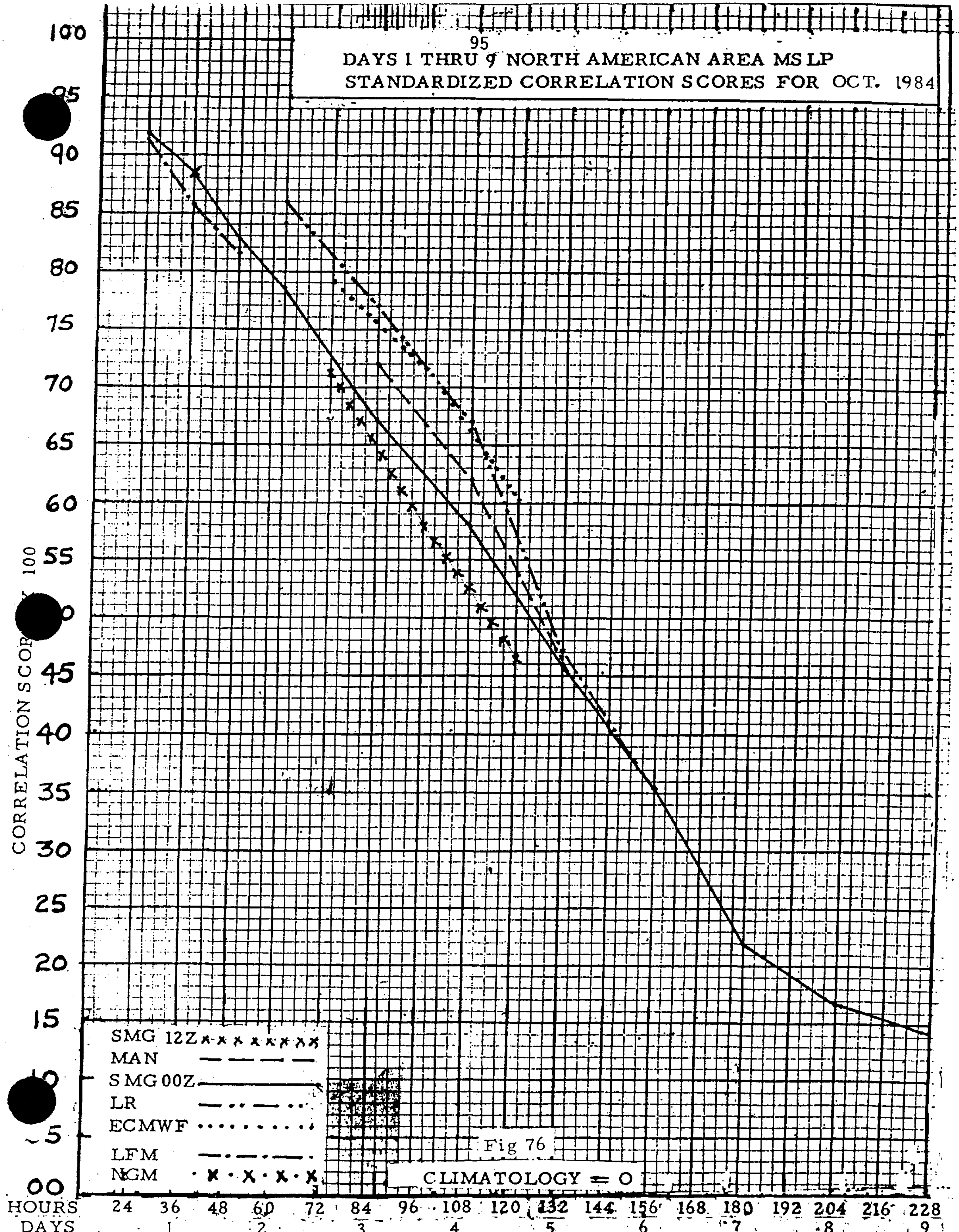
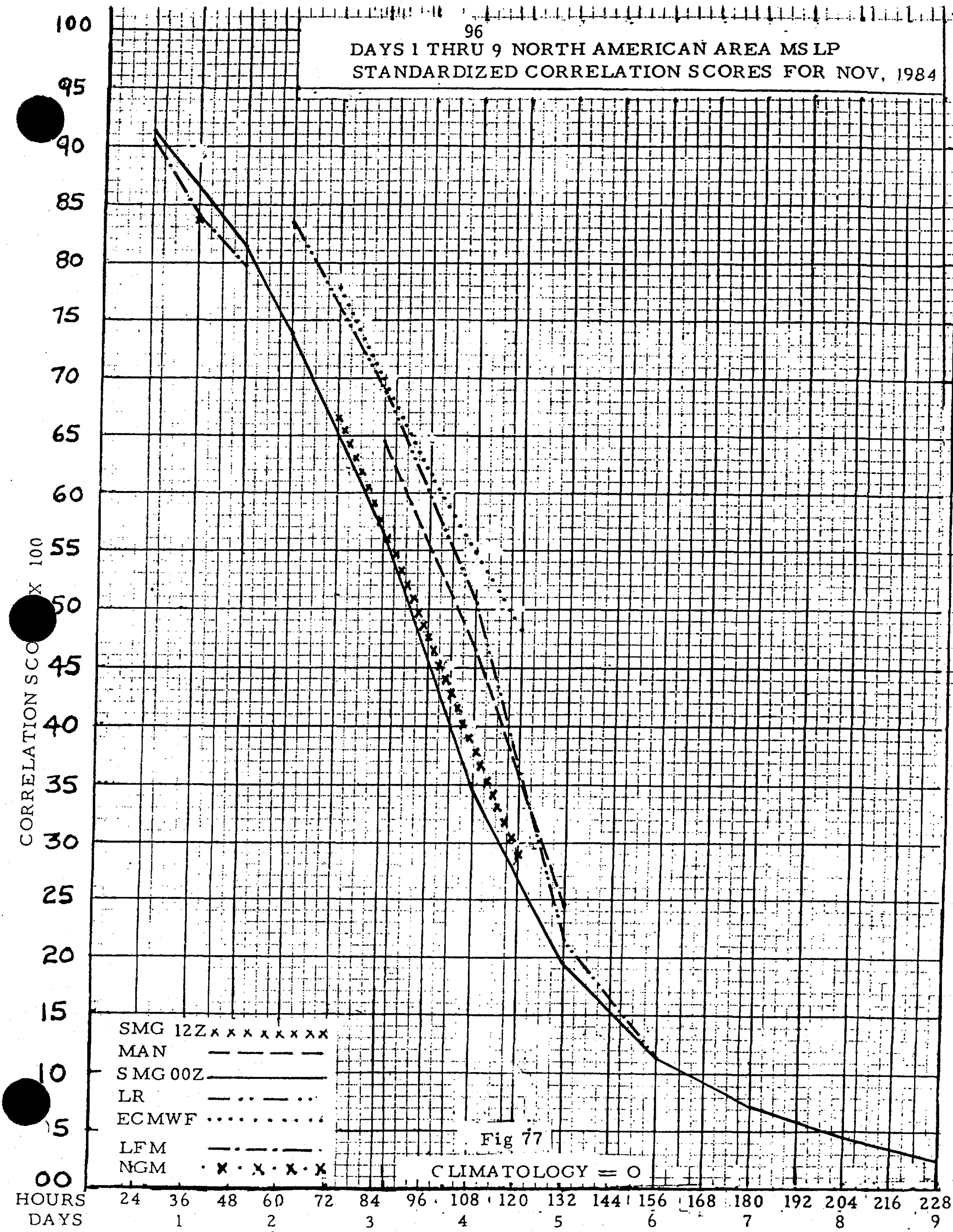

DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR SEP 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS
24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS
1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O

Fig 75


DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR OCT. 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS
DAYS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
1
2
3
4
5
6
7
8
9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O
Fig 76



96
DAYS 1 THRU 9 NORTH AMERICAN AREA MSLP
STANDARDIZED CORRELATION SCORES FOR NOV, 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O

Fig 77

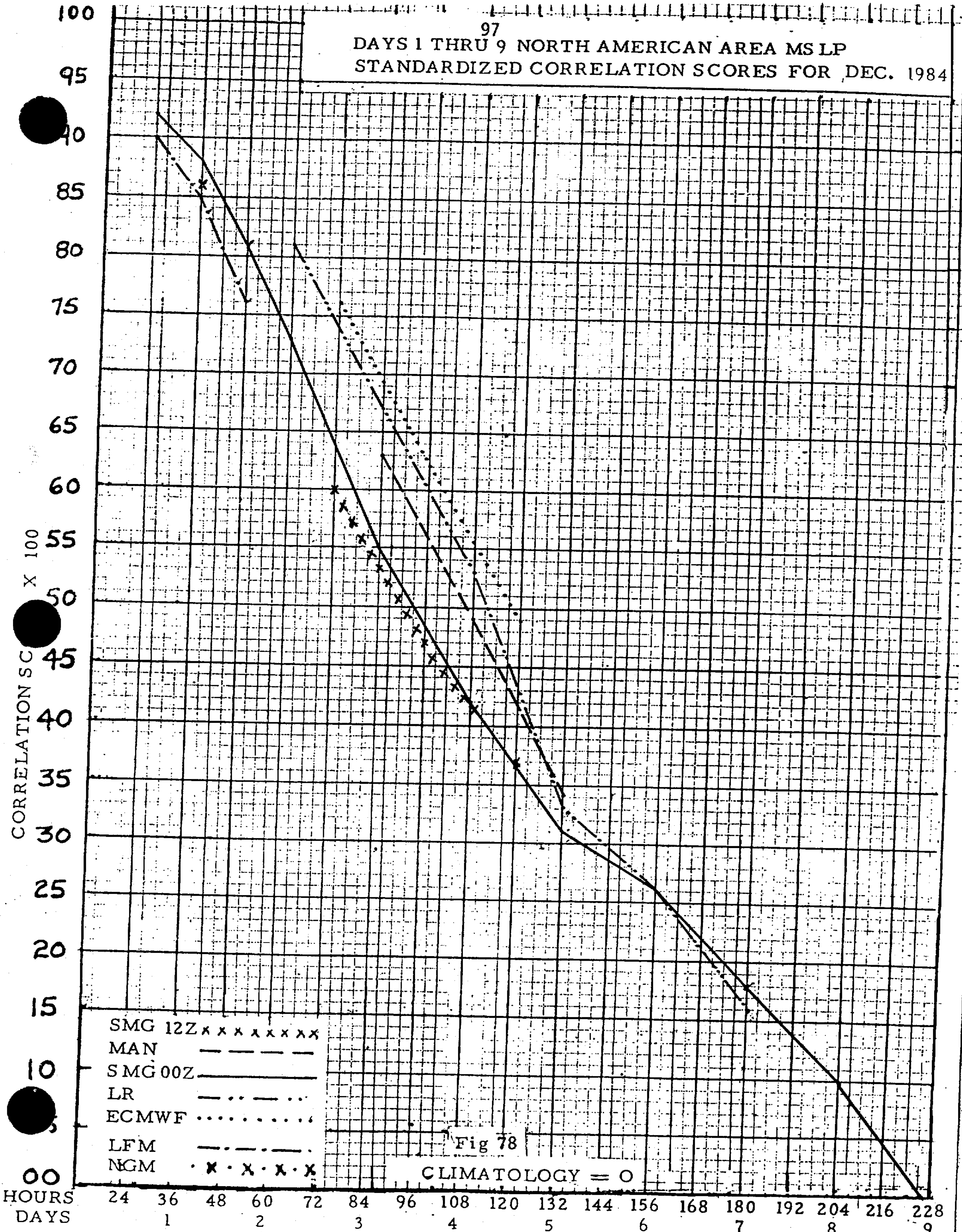

DAYS 1 THRU 9 NORTH AMERICAN AREA MS LP
STANDARDIZED CORRELATION SCORES FOR DEC. 1984
CORRELATION SC X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z x x x x x x x x
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O

Fig 78

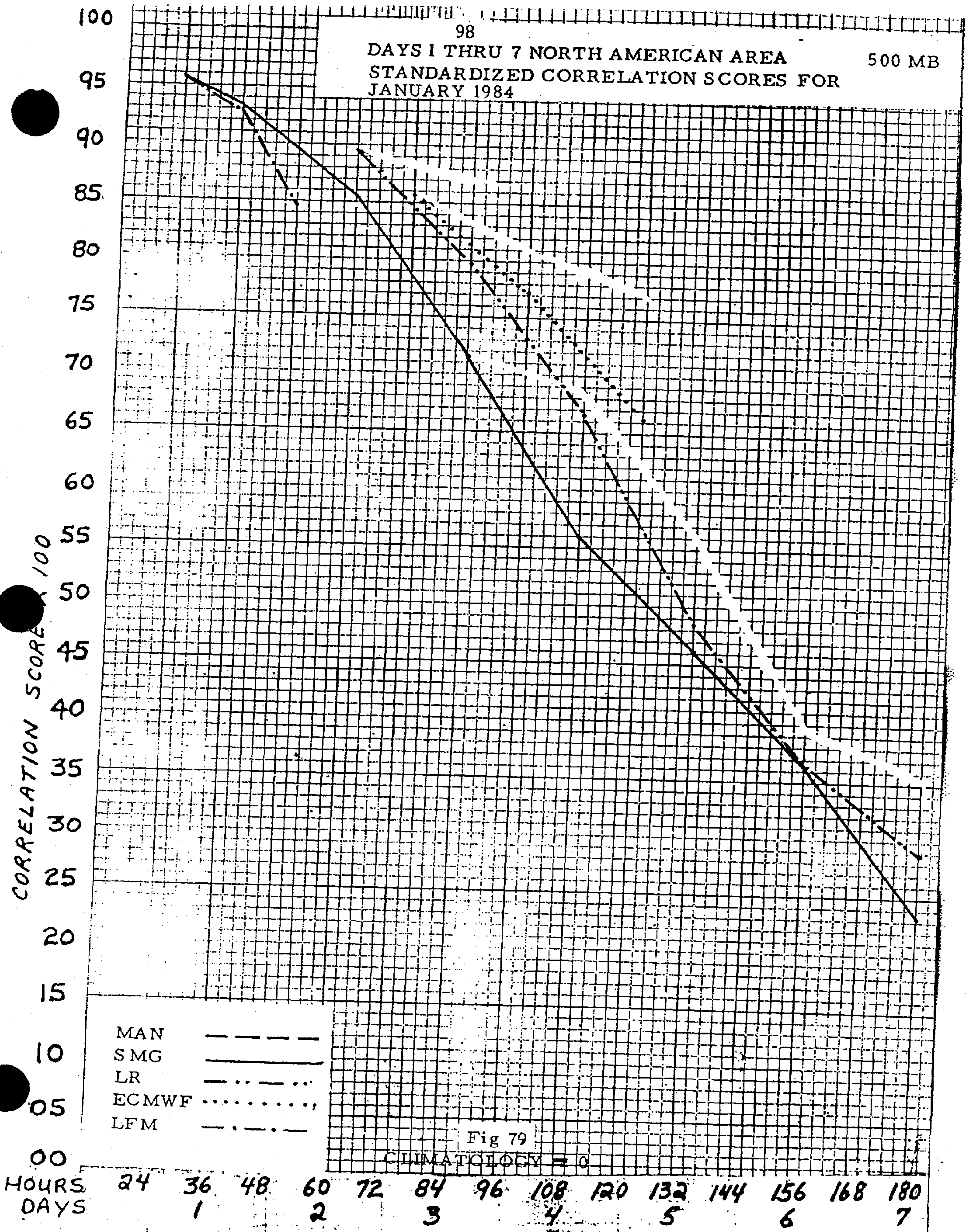

DAYS 1 THRU 7 NORTH AMERICAN AREA
STANDARDIZED CORRELATION SCORES FOR
JANUARY 1984
500 MB
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180
DAYS 1 2 3 4 5 6 7
MAN
SMG
LR
ECMWF
LFM
CLIMATOLOGY = 0

Fig 79

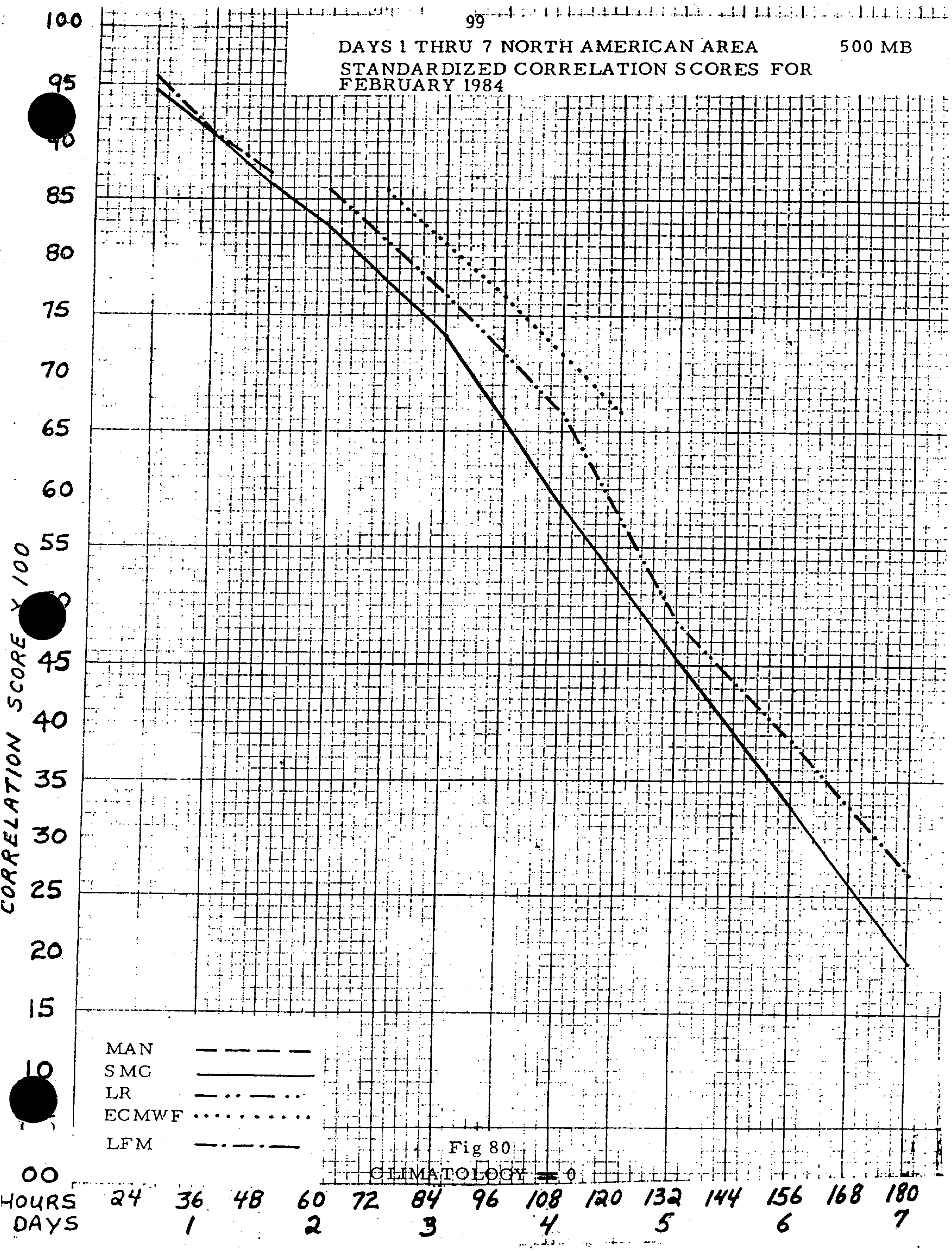
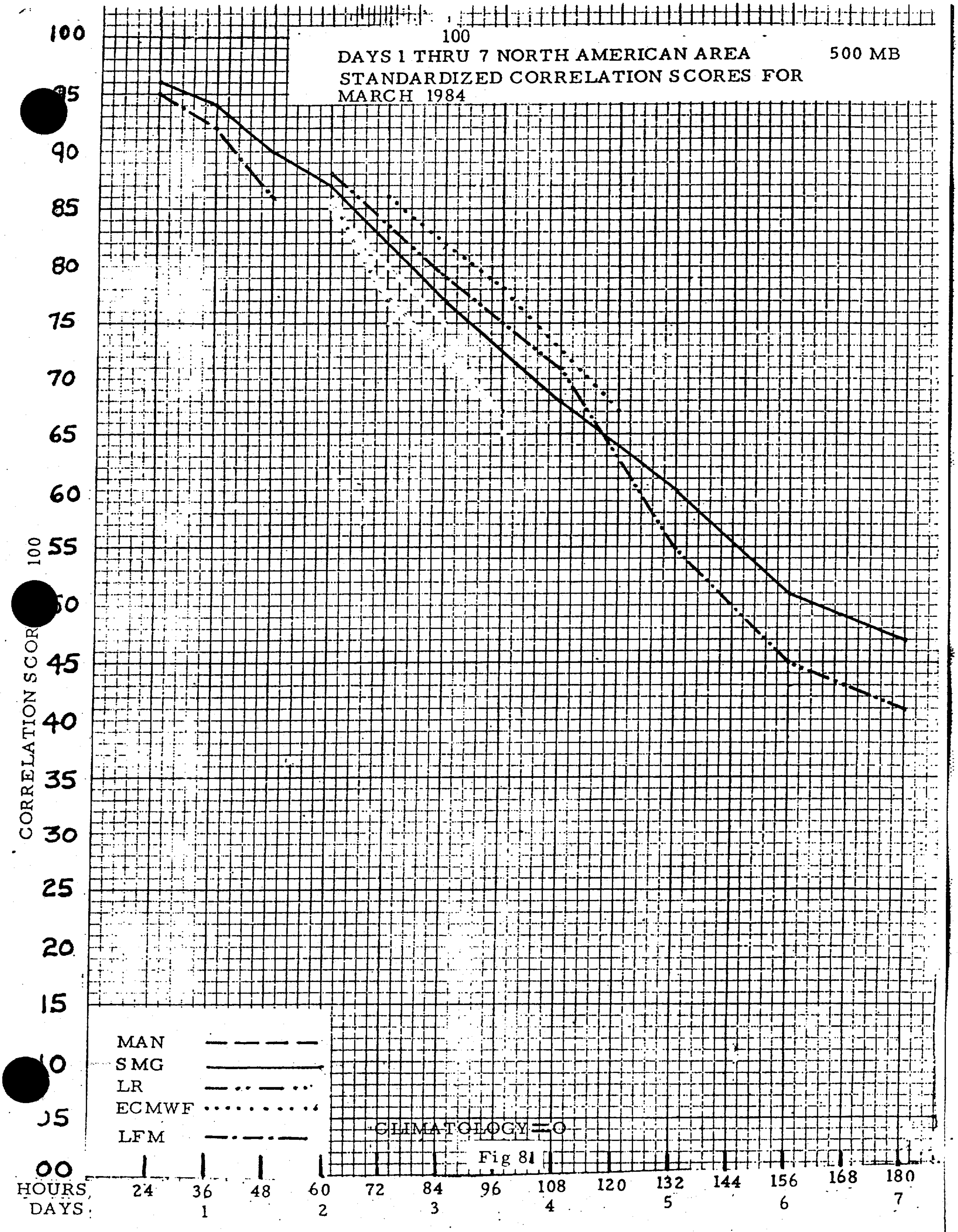

DAYS 1 THRU 7 NORTH AMERICAN AREA
500 MB
STANDARDIZED CORRELATION SCORES FOR FEBRUARY 1984
CORRELATION SCORE X 100
100
95
85
80
75
70
65
60
55
45
40
35
30
25
20
15
00
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
DAYS
1
2
3
4
5
6
7
MAN
SMG
LR
ECMWF
LFM
CLIMATOLOGY = 0

Fig 80


100
DAYS 1 THRU 7 NORTH AMERICAN AREA
500 MB
STANDARDIZED CORRELATION SCORES FOR
MARCH 1984
CORRELATION SCORE
MAN
SMG
LR
ECMWF
LFM
CLIMATOLOGY = 0
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180
DAYS 1 2 3 4 5 6 7
Fig 81

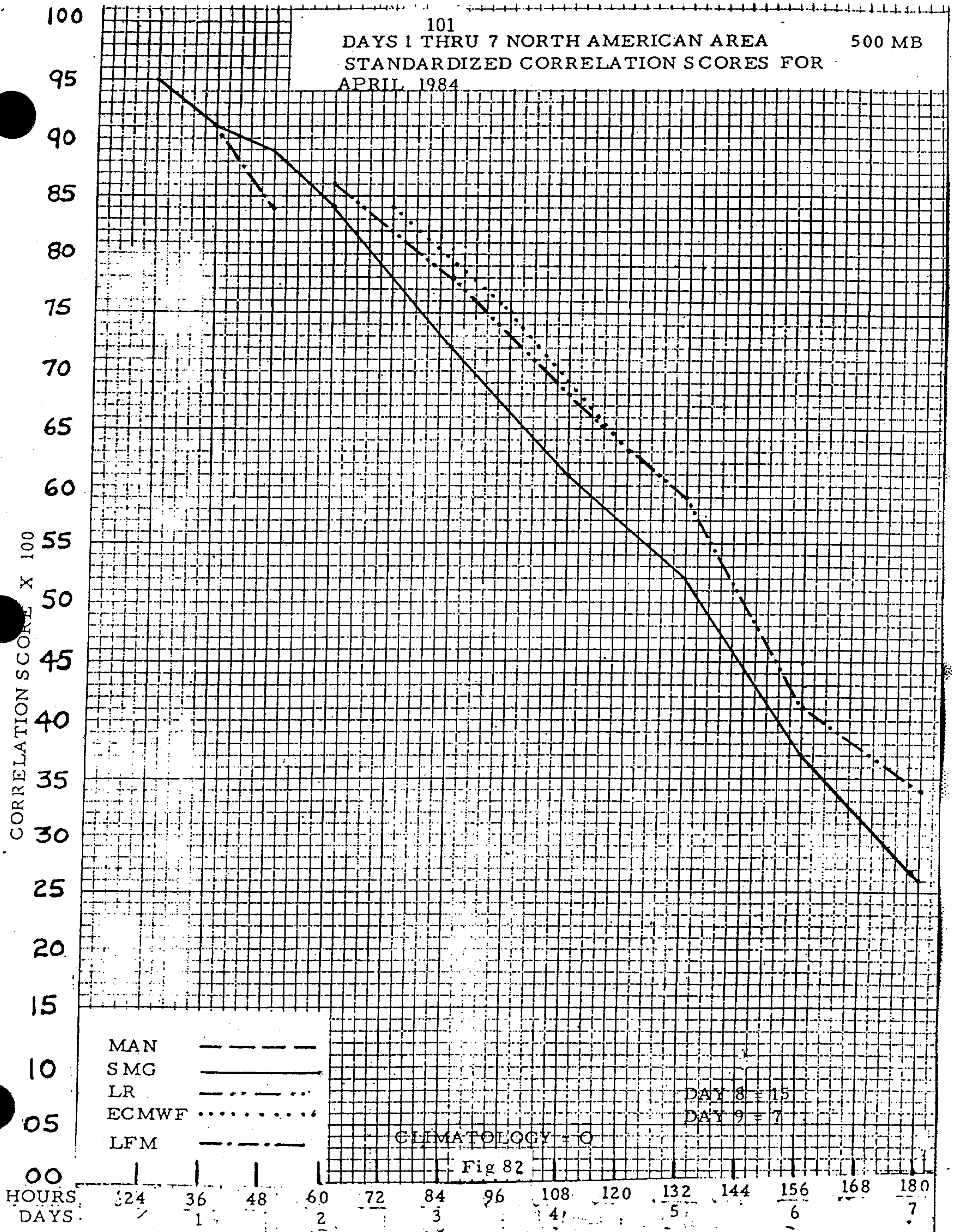

DAYS 1 THRU 7 NORTH AMERICAN AREA
500 MB
STANDARDIZED CORRELATION SCORES FOR
APRIL 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
MAN
SMG
LR
ECMWF
LFM
DAY 8 = 15
DAY 9 = 7
CLIMATOLOGY = O
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
DAYS
1
2
3
4
5
6
7

Fig 82

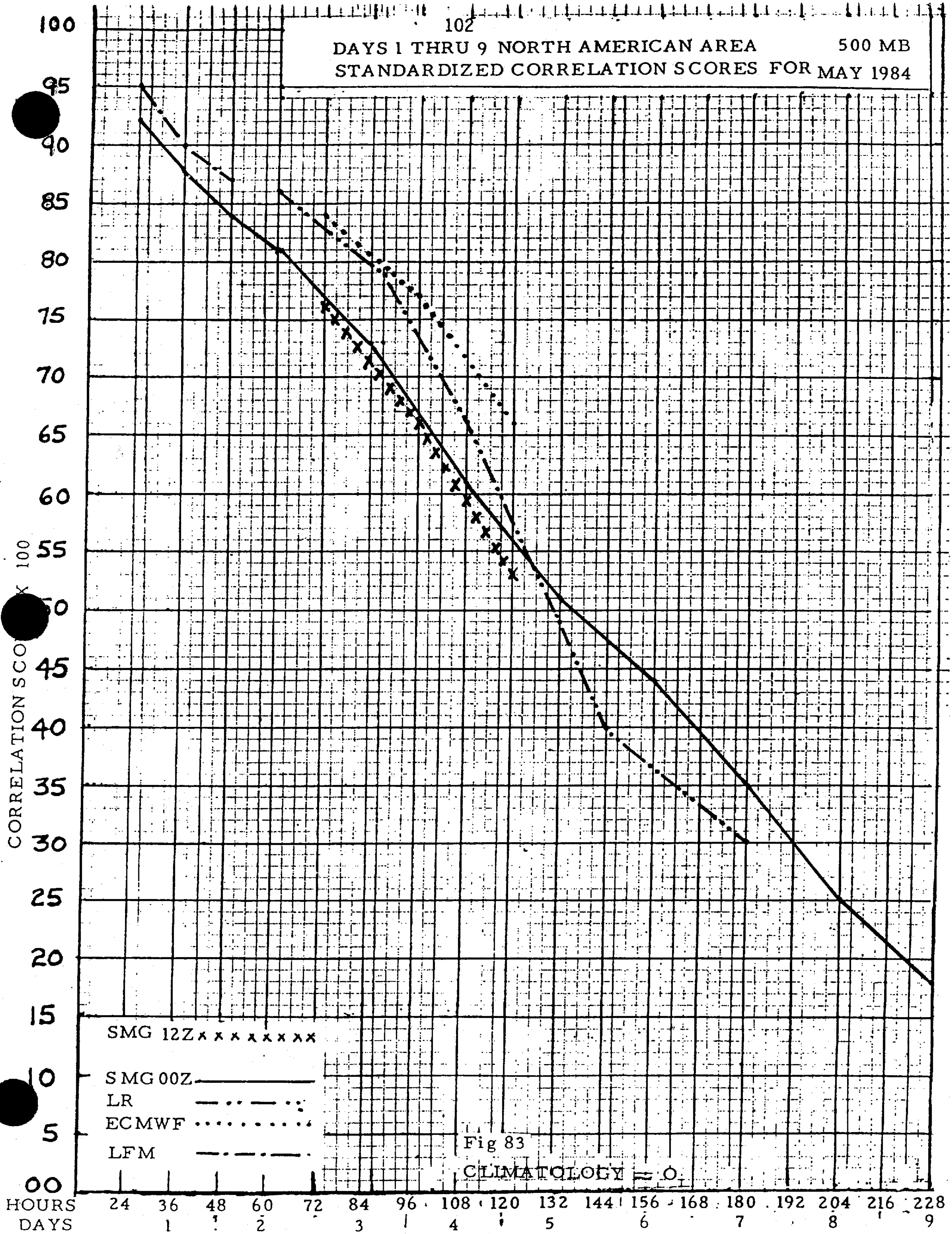
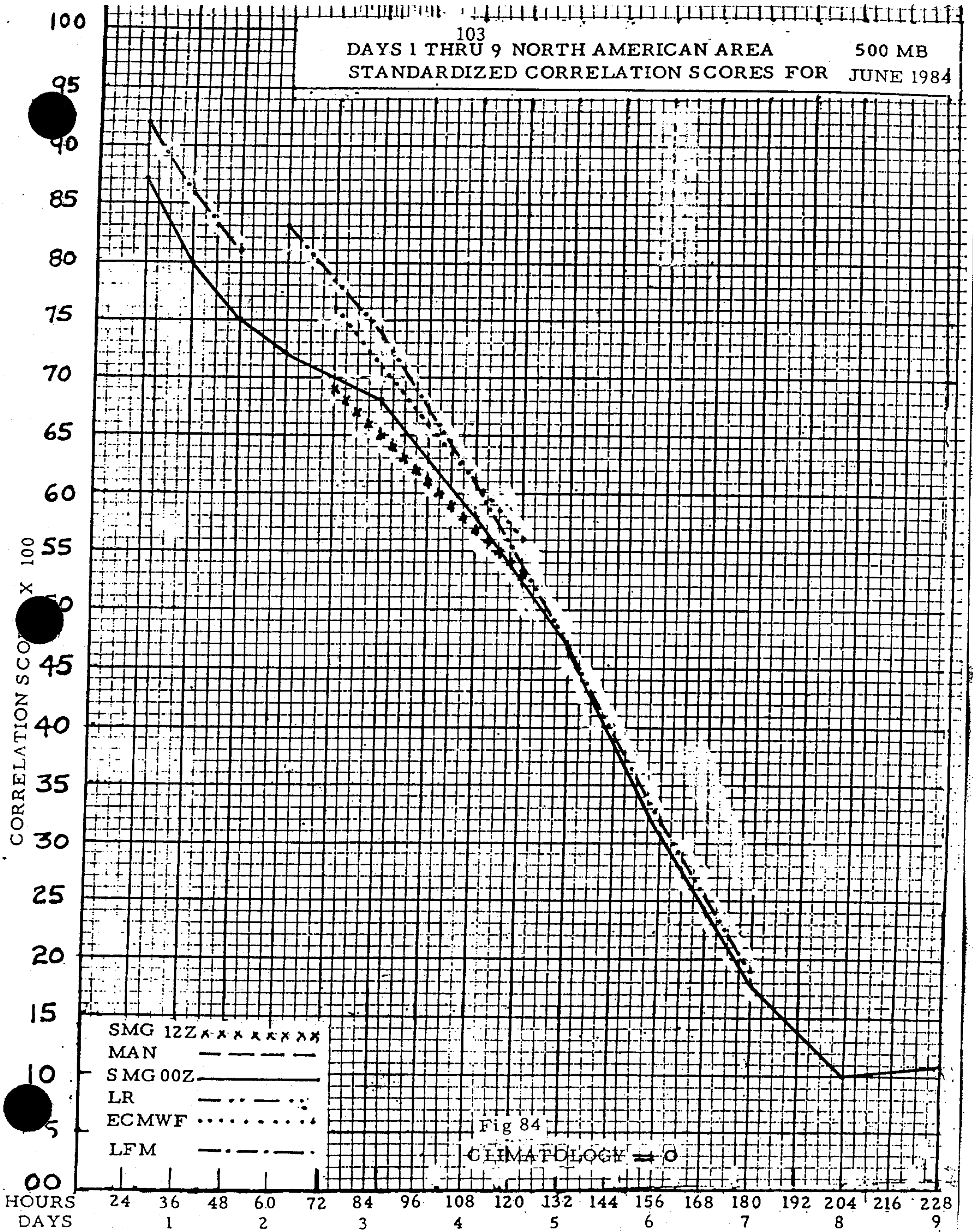

DAYS 1 THRU 9 NORTH AMERICAN AREA
500 MB
STANDARDIZED CORRELATION SCORES FOR MAY 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS
24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS
1 2 3 4 5 6 7 8 9
SMG 12Z
SMG 00Z
LR
ECMWF
LFM
CLIMATOLOGY = O

Fig 83


DAYS 1 THRU 9 NORTH AMERICAN AREA 500 MB
STANDARDIZED CORRELATION SCORES FOR JUNE 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
CLIMATOLOGY = 0
Fig 84

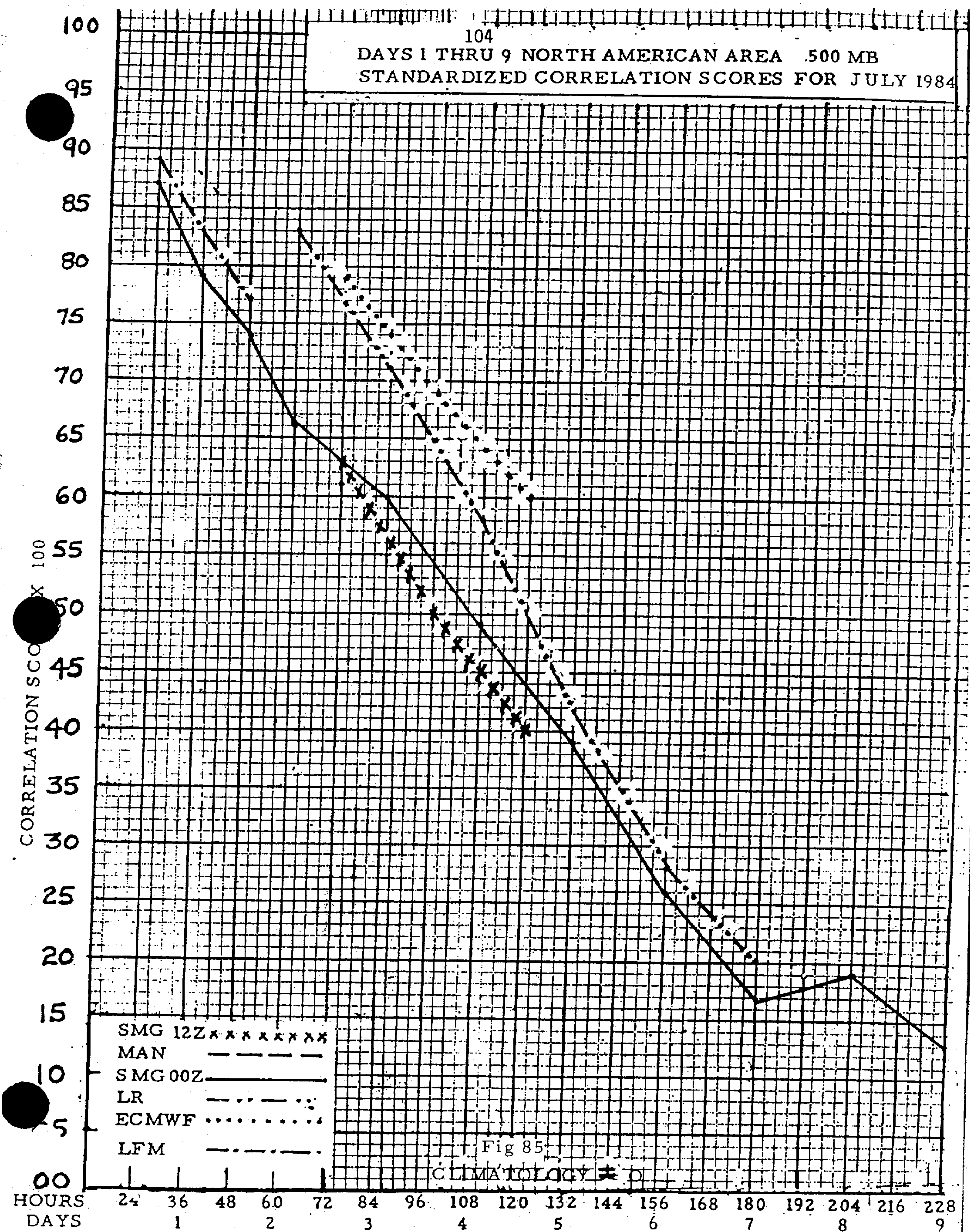

DAYS 1 THRU 9 NORTH AMERICAN AREA .500 MB
STANDARDIZED CORRELATION SCORES FOR JULY 1984
CORRELATION SCO[RE] X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
DAYS
1
2
3
4
5
6
7
8
9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
CLIMATOLOGY

Fig 85

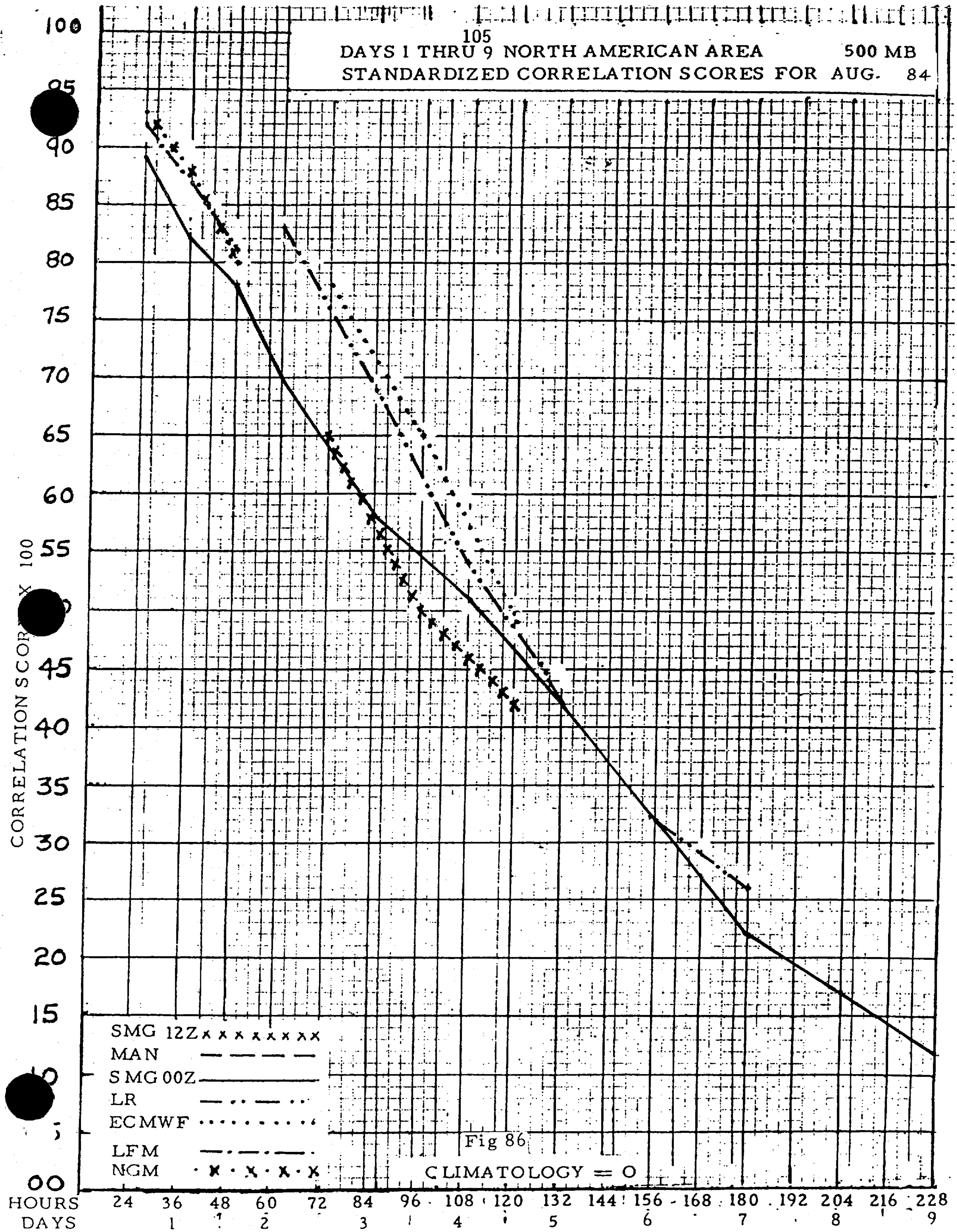

DAYS 1 THRU 9 NORTH AMERICAN AREA 500 MB
STANDARDIZED CORRELATION SCORES FOR AUG. 84
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
DAYS
1
2
3
4
5
6
7
8
9
SMG 12Z x x x x x x x x x
MAN — — — —
SMG 00Z ————
LR — · · — · ·
ECMWF · · · · · · · ·
LFM — · — · —
NGM · x · x · x · x
CLIMATOLOGY = O

Fig 86

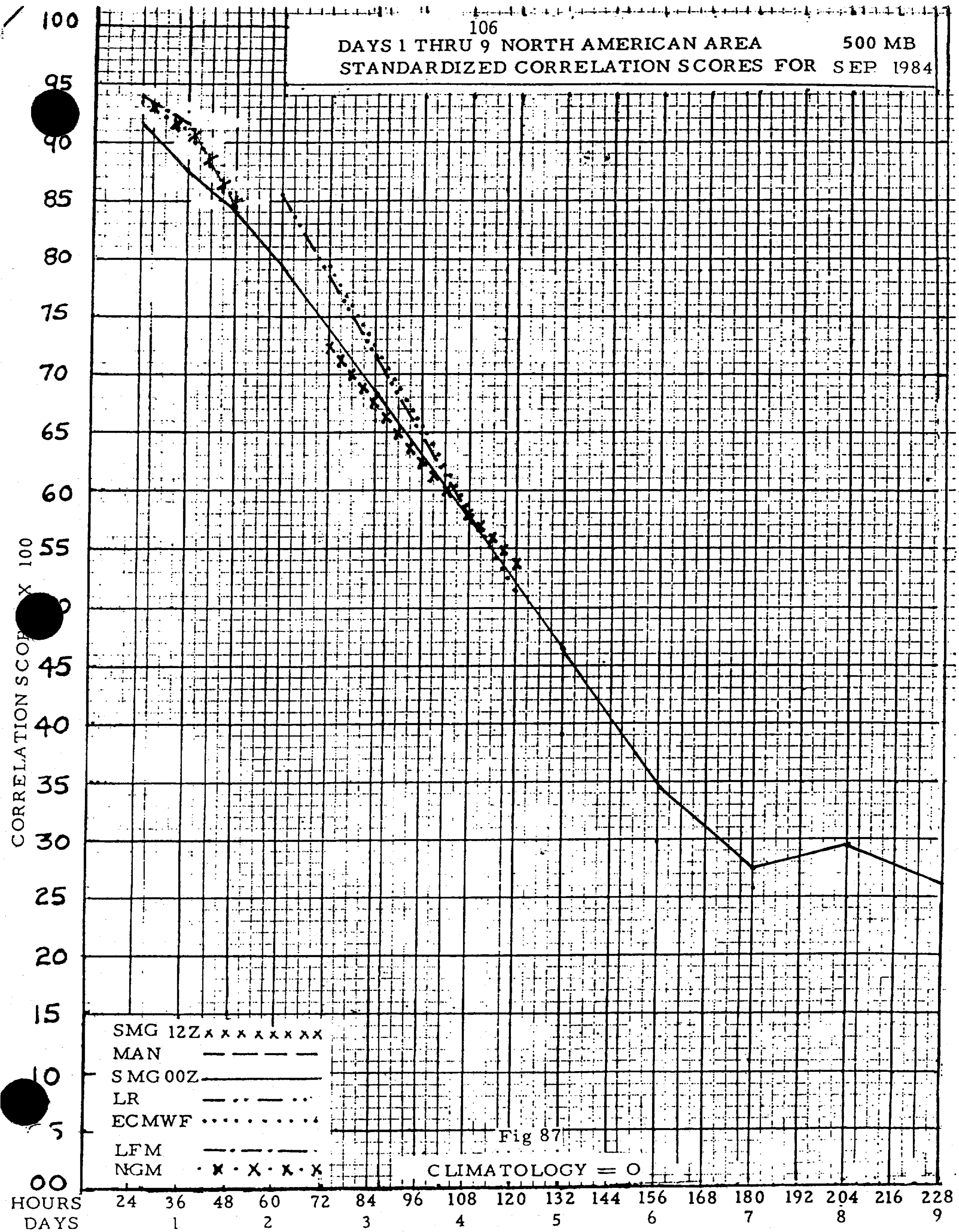

DAYS 1 THRU 9 NORTH AMERICAN AREA 500 MB
STANDARDIZED CORRELATION SCORES FOR SEP 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
45
40
35
30
25
20
15
10
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O

Fig 87

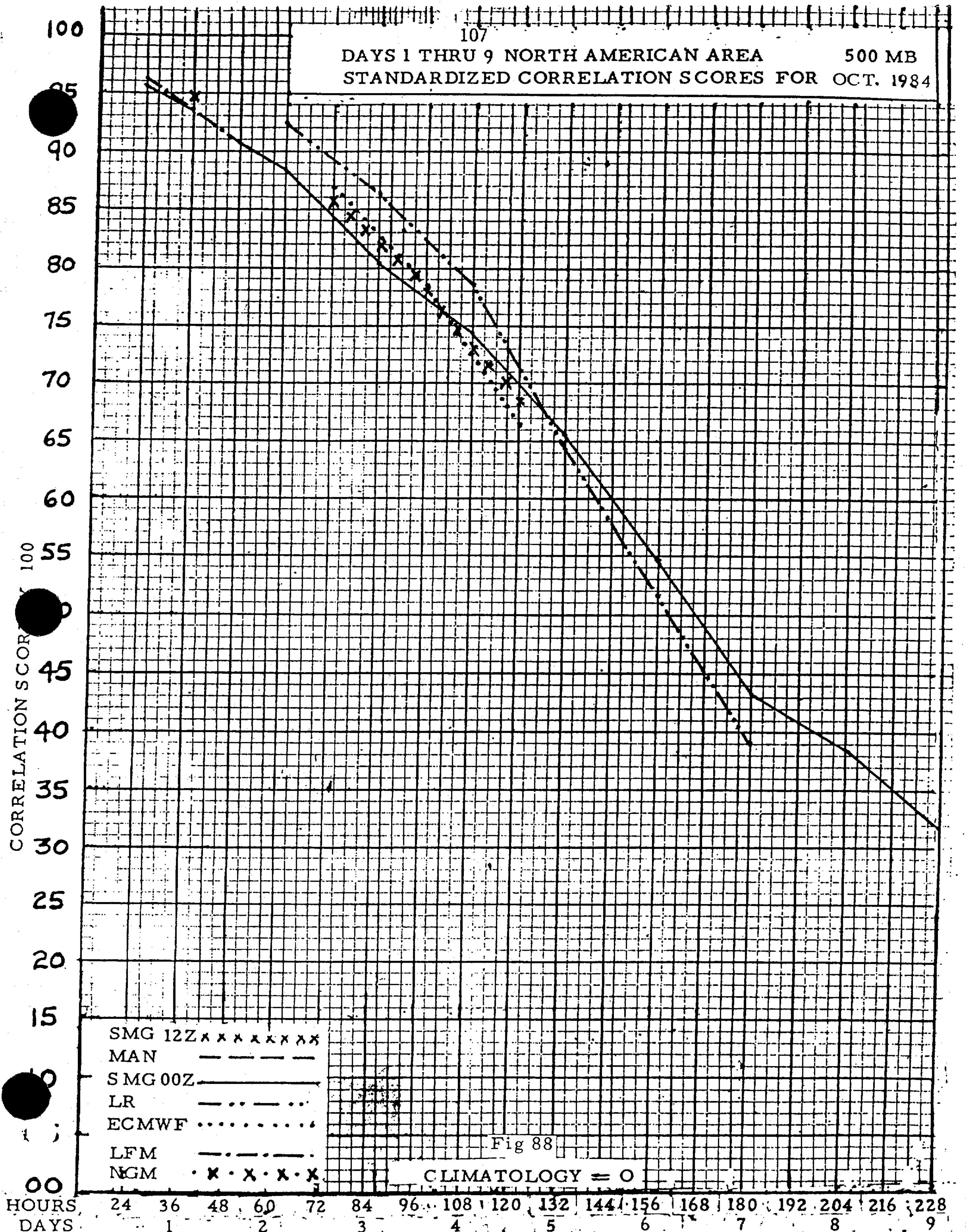
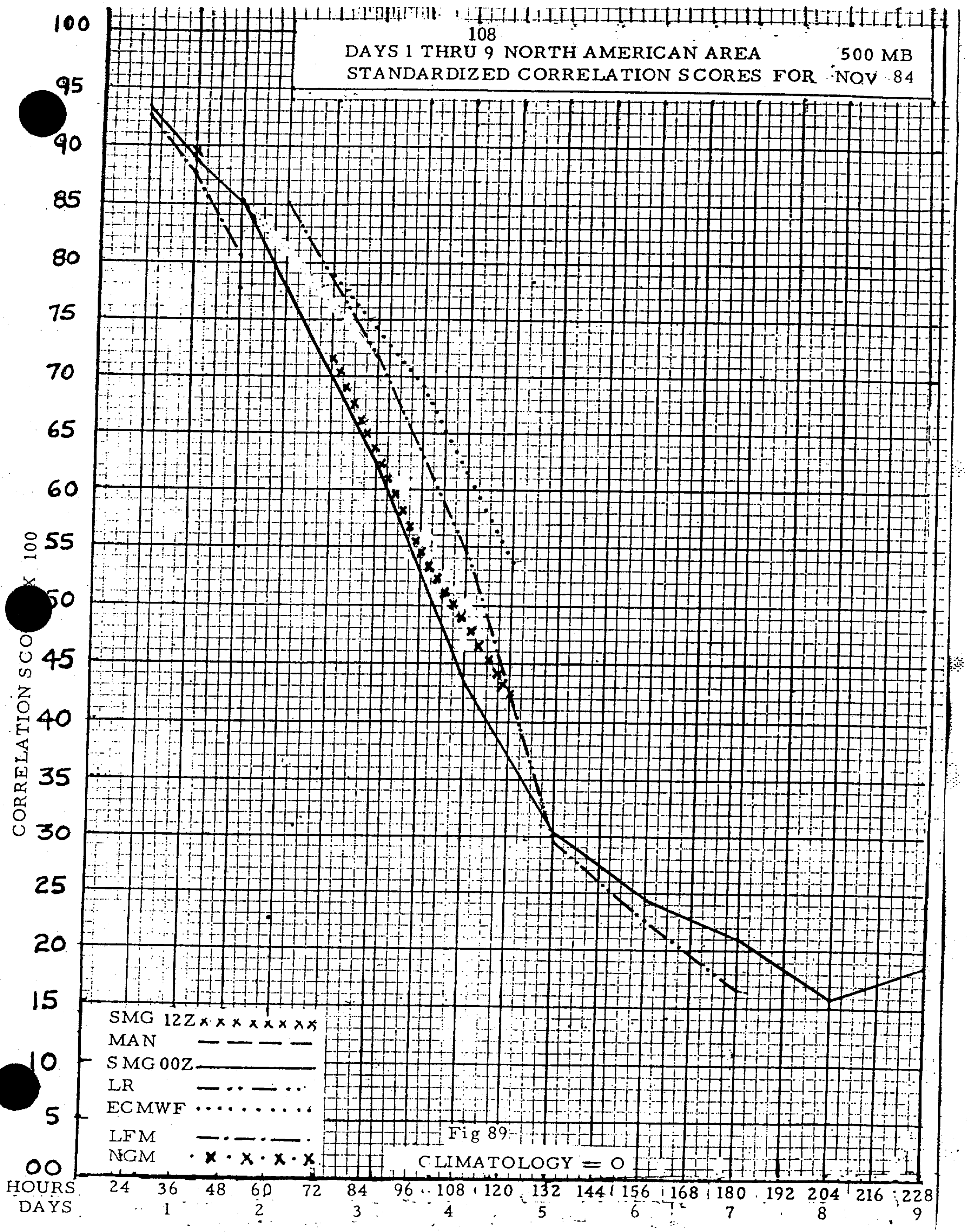

DAYS 1 THRU 9 NORTH AMERICAN AREA 500 MB
STANDARDIZED CORRELATION SCORES FOR OCT. 1984
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9

Fig 88


DAYS 1 THRU 9 NORTH AMERICAN AREA
STANDARDIZED CORRELATION SCORES FOR
500 MB
NOV 84
CORRELATION SCORE X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
00
HOURS
DAYS
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
1
2
3
4
5
6
7
8
9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O
Fig 89

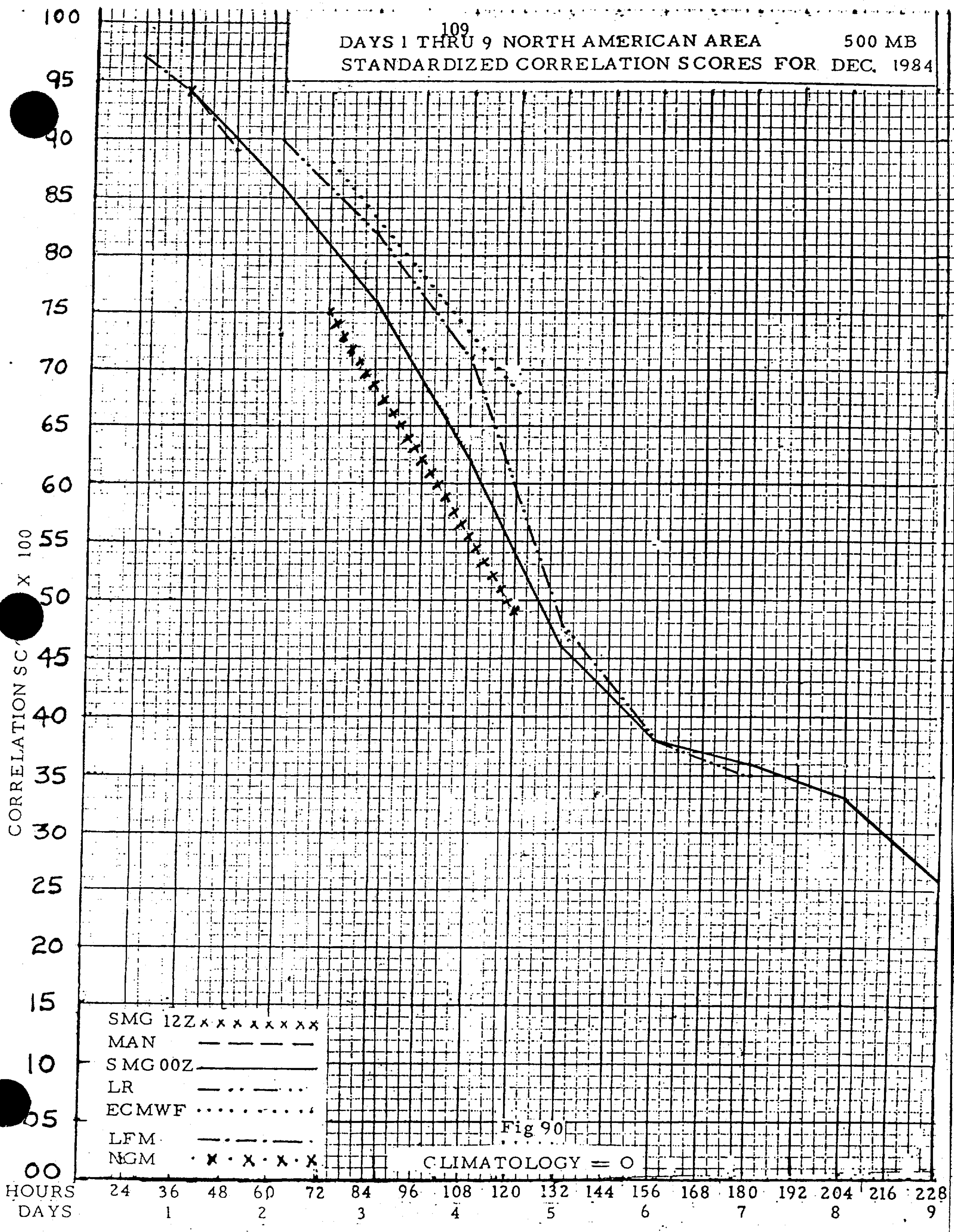

DAYS 1 THRU 9 NORTH AMERICAN AREA 500 MB
STANDARDIZED CORRELATION SCORES FOR DEC. 1984
CORRELATION SC X 100
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
05
00
HOURS 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228
DAYS 1 2 3 4 5 6 7 8 9
SMG 12Z
MAN
SMG 00Z
LR
ECMWF
LFM
NGM
CLIMATOLOGY = O

Fig 90

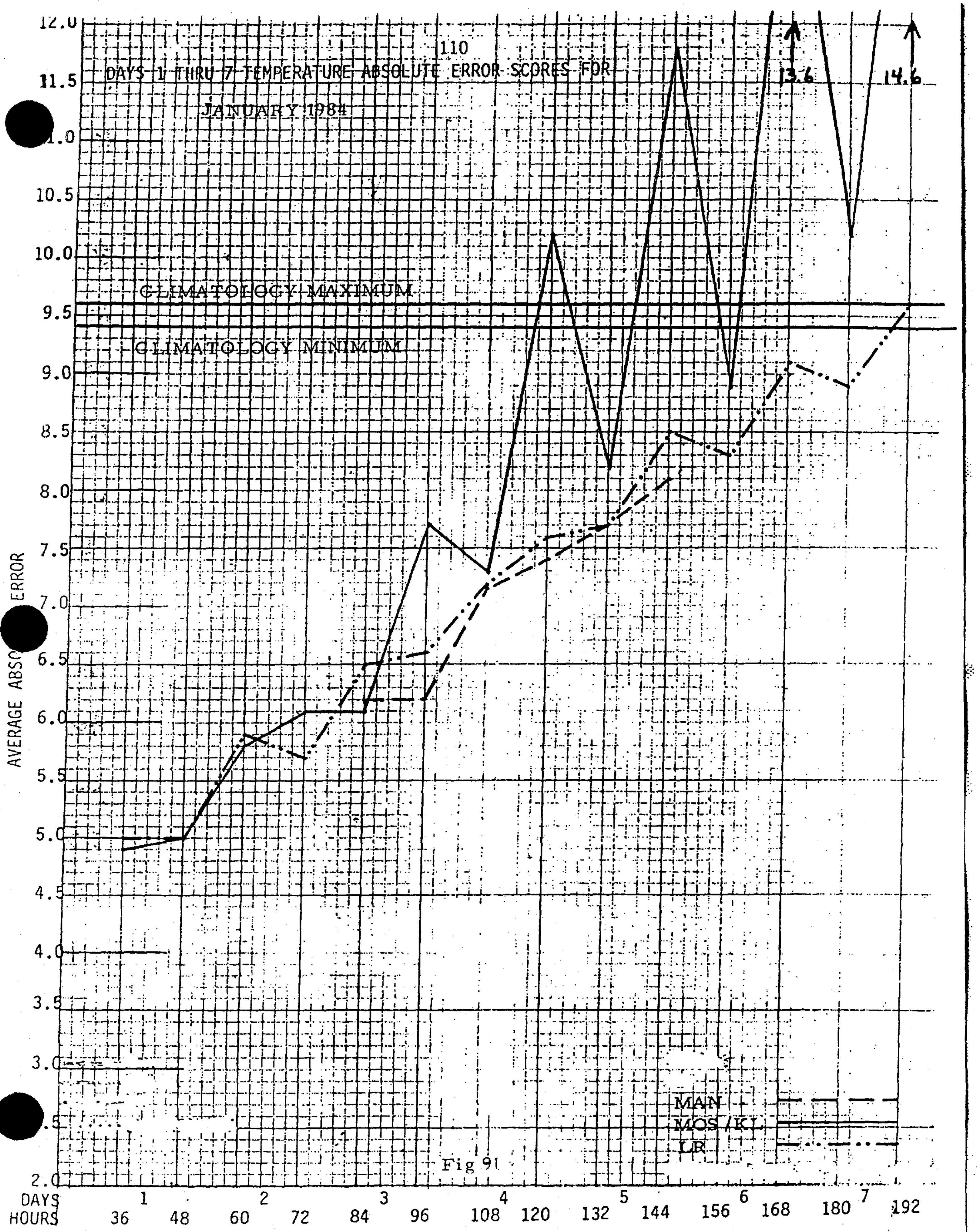

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR
JANUARY 1984
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
13.6
14.6
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 91

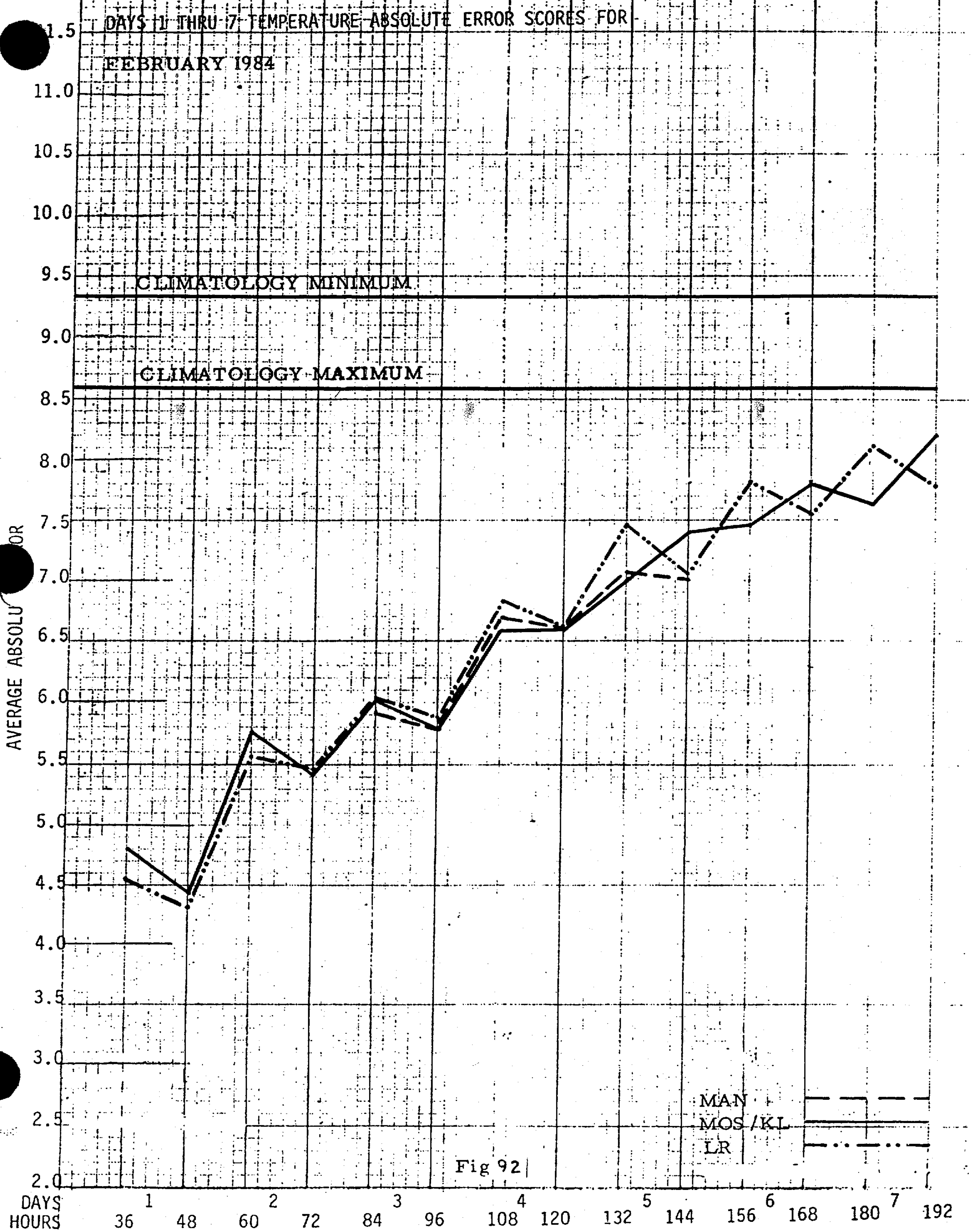

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR
FEBRUARY 1984
CLIMATOLOGY MINIMUM
CLIMATOLOGY MAXIMUM
AVERAGE ABSOLU[...]OR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
DAYS
1
2
3
4
5
6
7
HOURS
36
48
60
72
84
96
108
120
132
144
156
168
180
192
MAN
MOS/KL
LR

Fig 92

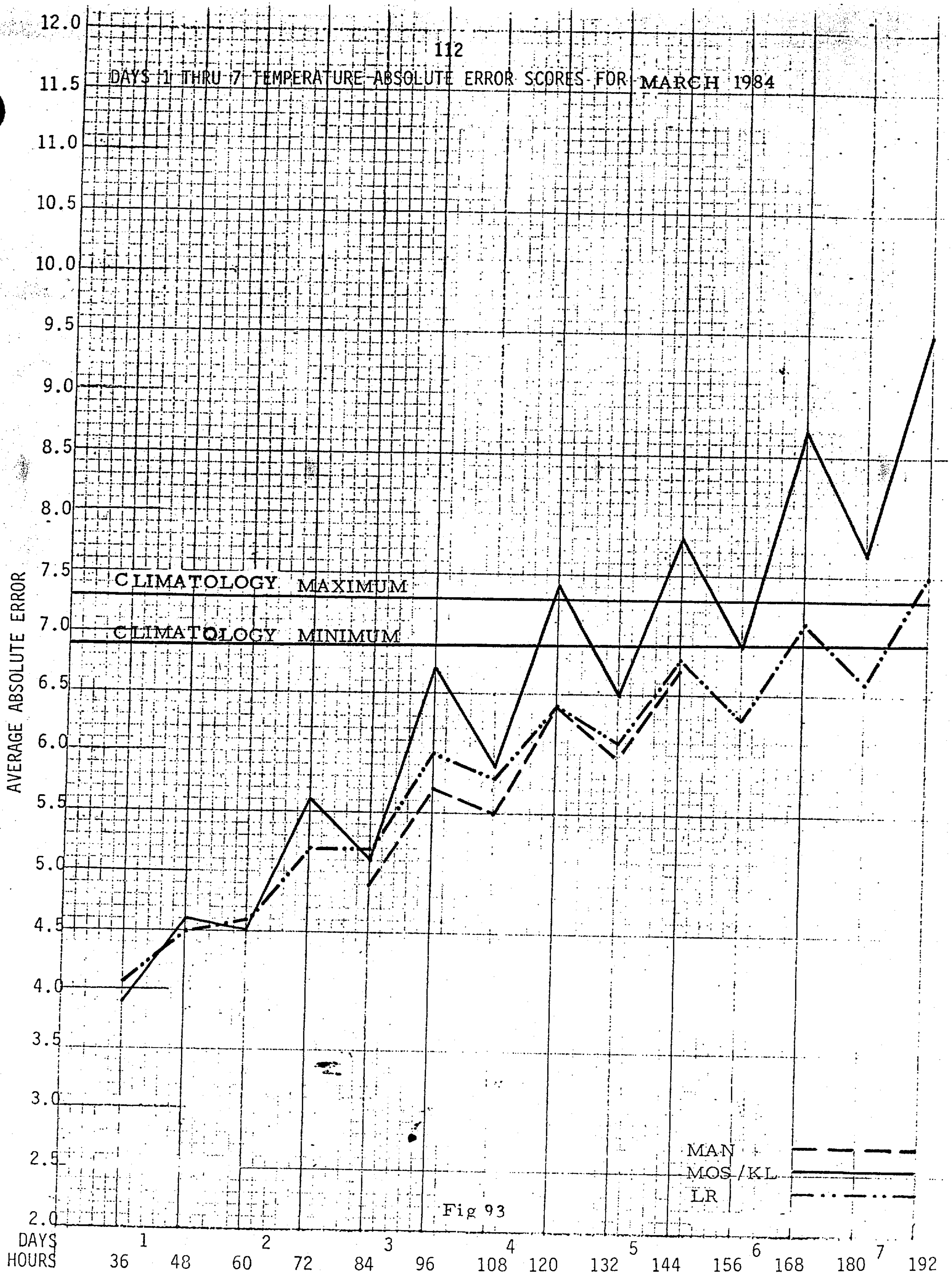

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR MARCH 1984
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
MAN
MOS/KL
LR
DAYS
1
2
3
4
5
6
7
HOURS
36
48
60
72
84
96
108
120
132
144
156
168
180
192

Fig 93

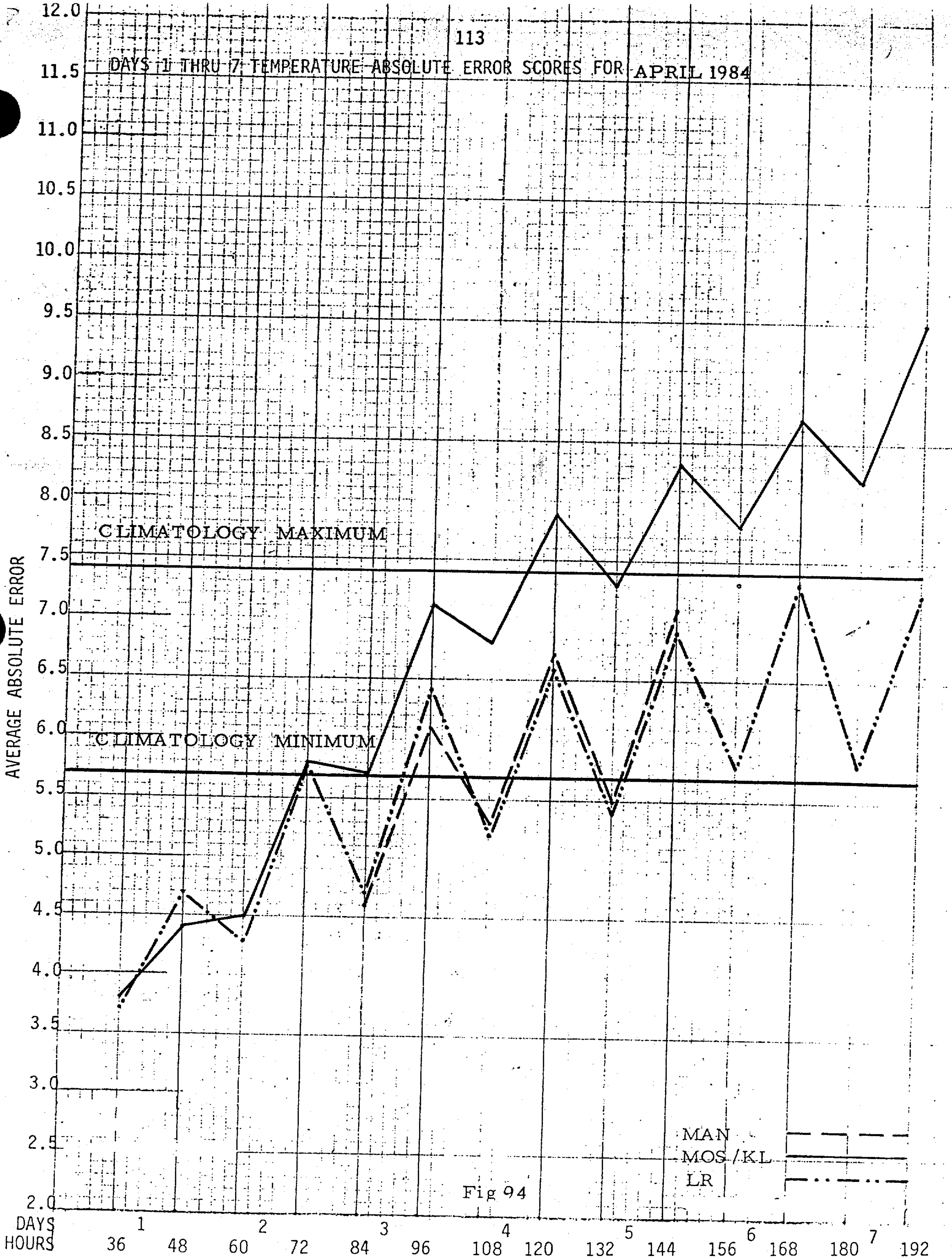
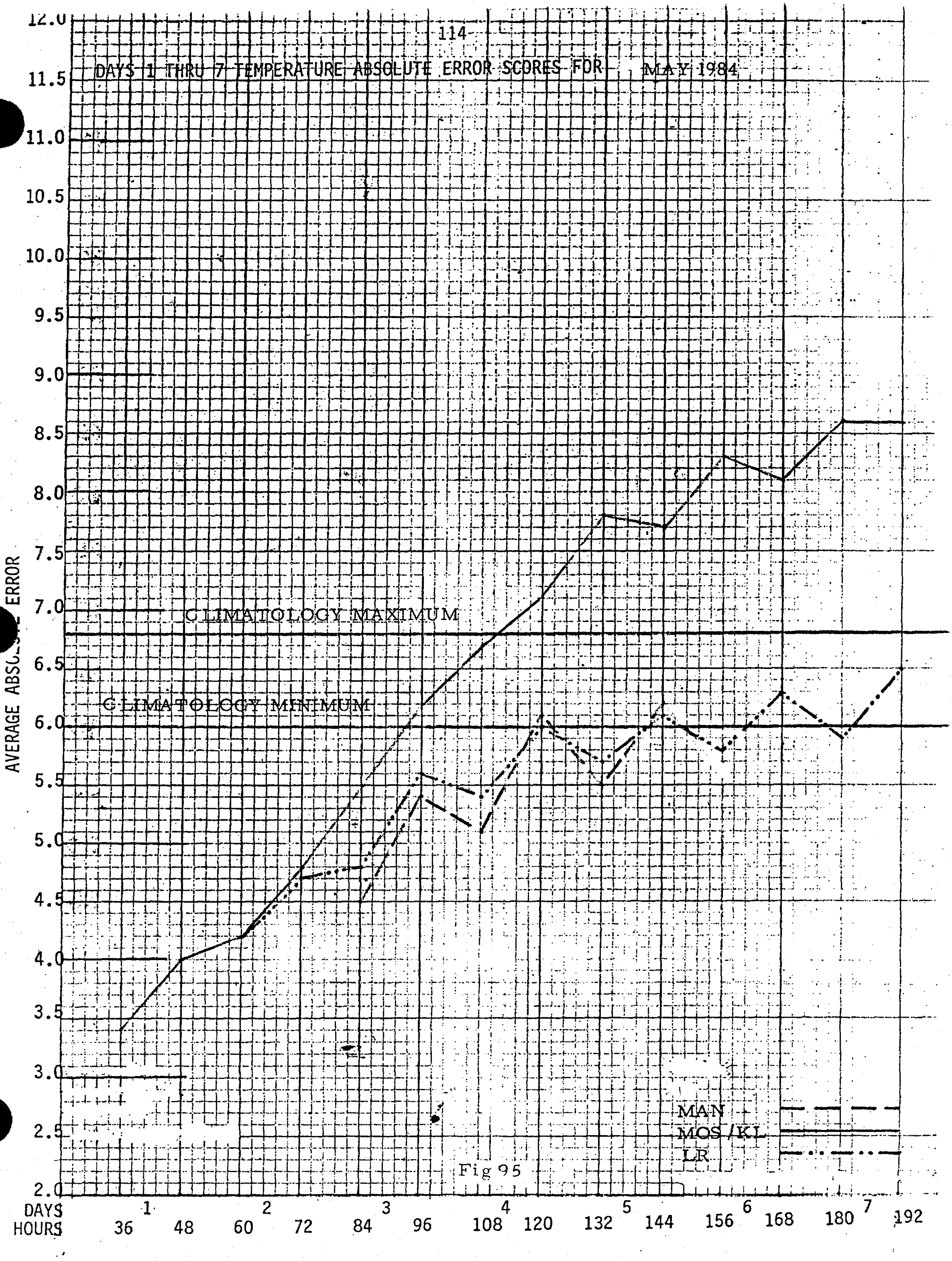

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR APRIL 1984
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192
MAN
MOS/KL
LR

Fig 94


DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR MAY 1984
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192
Fig 95

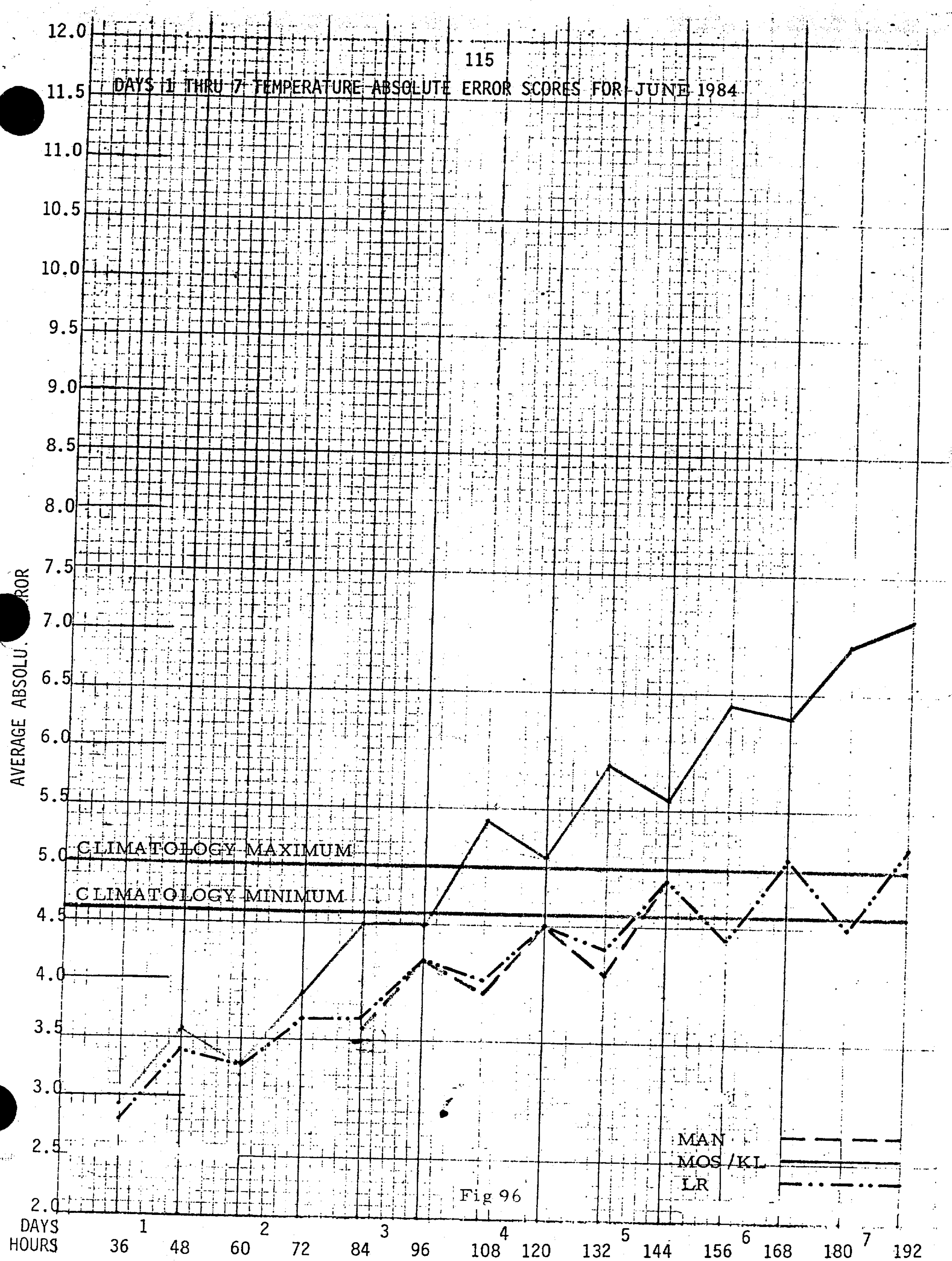

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR JUNE 1984
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
AVERAGE ABSOLU... ROR
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 96

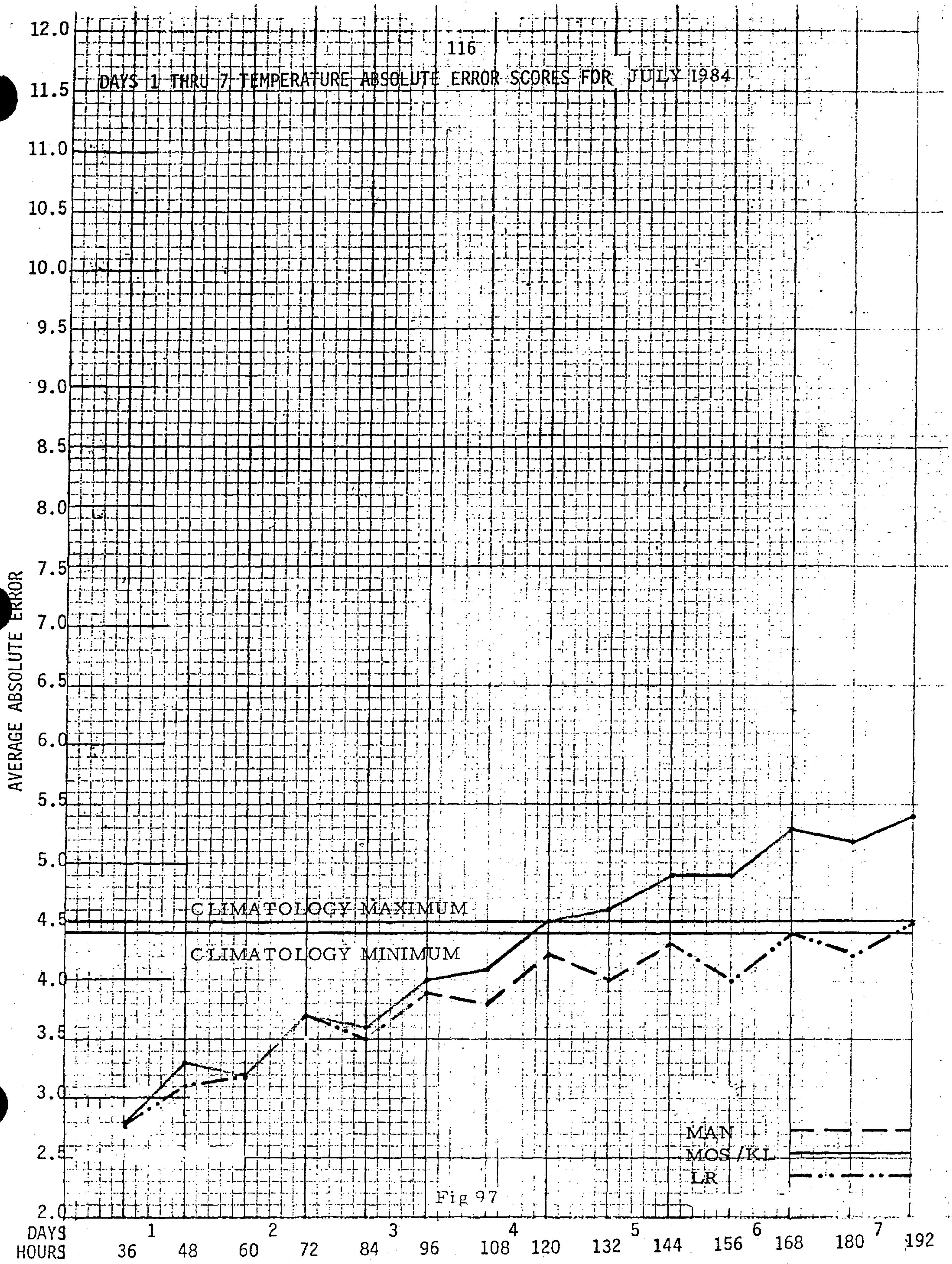

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR JULY 1984
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 97

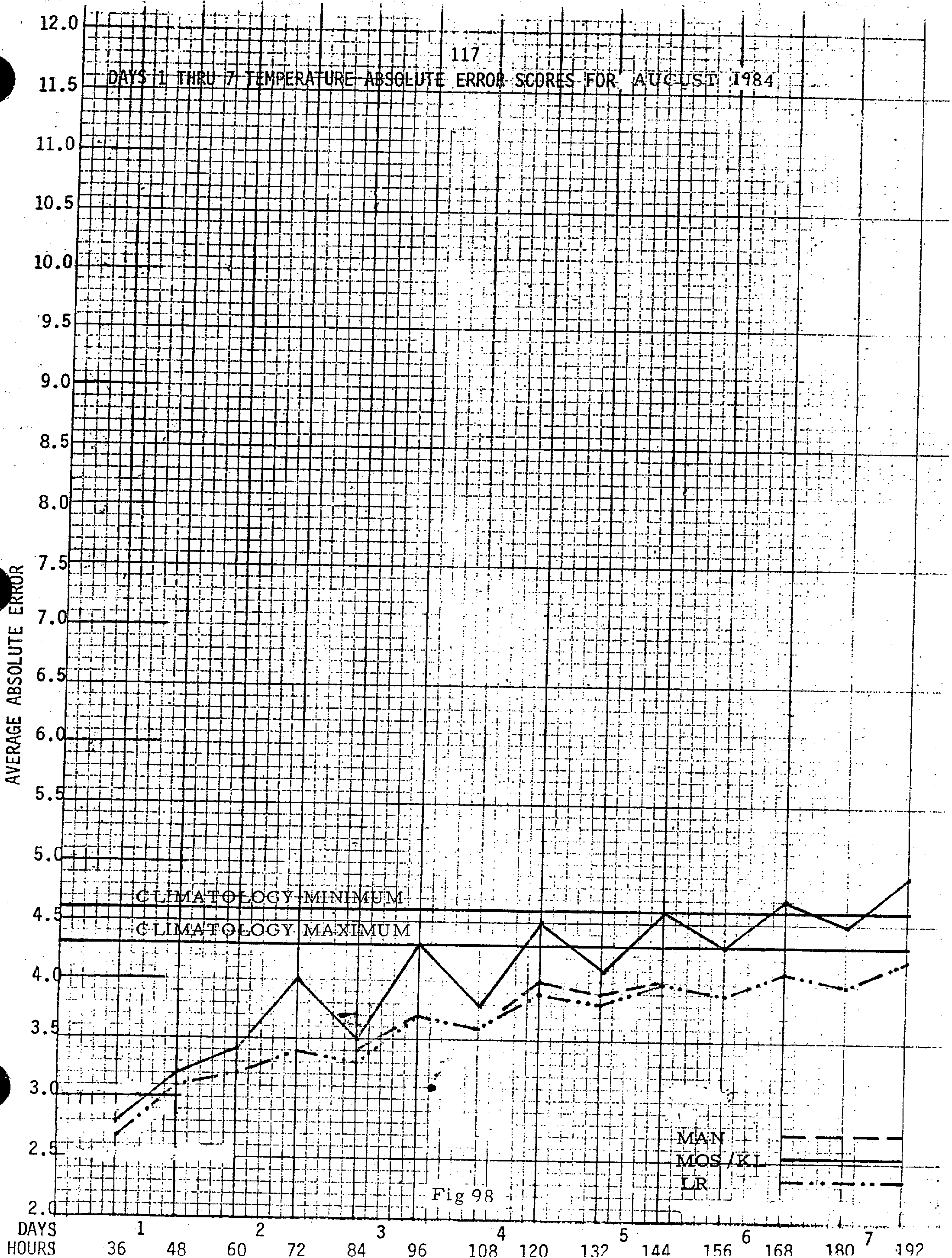
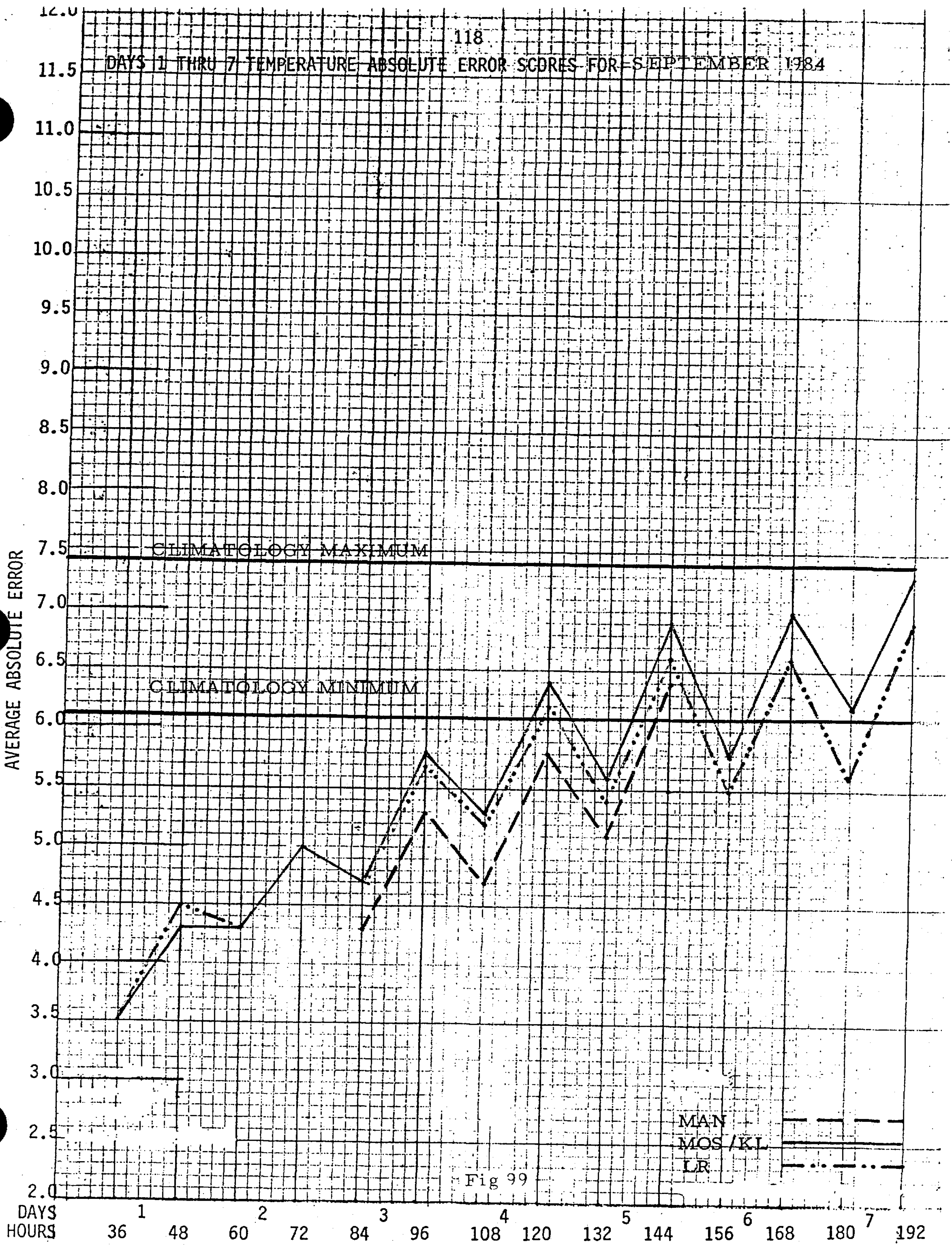

DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR AUGUST 1984
AVERAGE ABSOLUTE ERROR
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
CLIMATOLOGY MINIMUM
CLIMATOLOGY MAXIMUM
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 98


DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR SEPTEMBER 1984
AVERAGE ABSOLUTE ERROR
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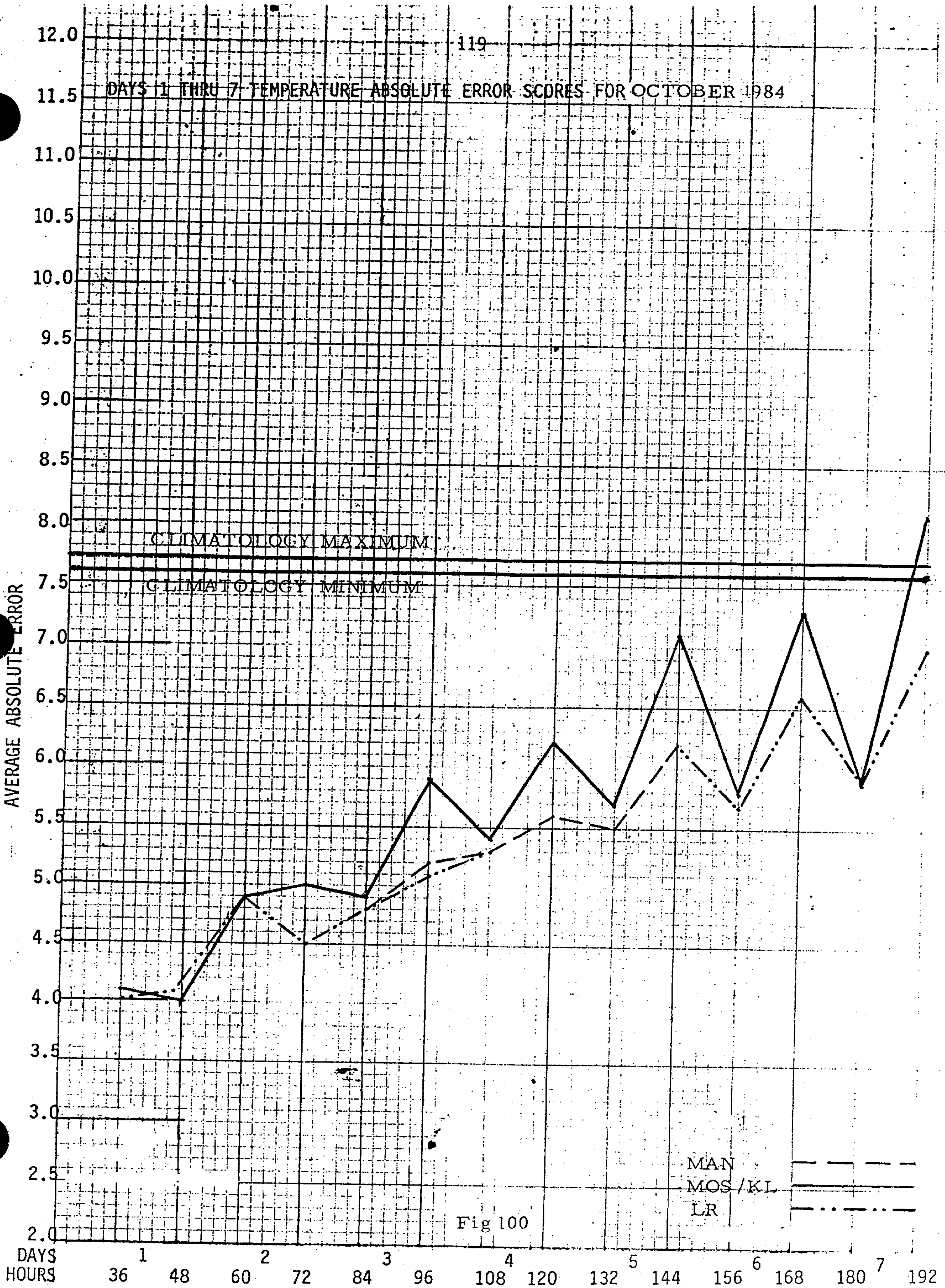
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 99


DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR OCTOBER 1984
CLIMATOLOGY MAXIMUM
CLIMATOLOGY MINIMUM
AVERAGE ABSOLUTE ERROR
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11.5
11.0
10.5
10.0
9.5
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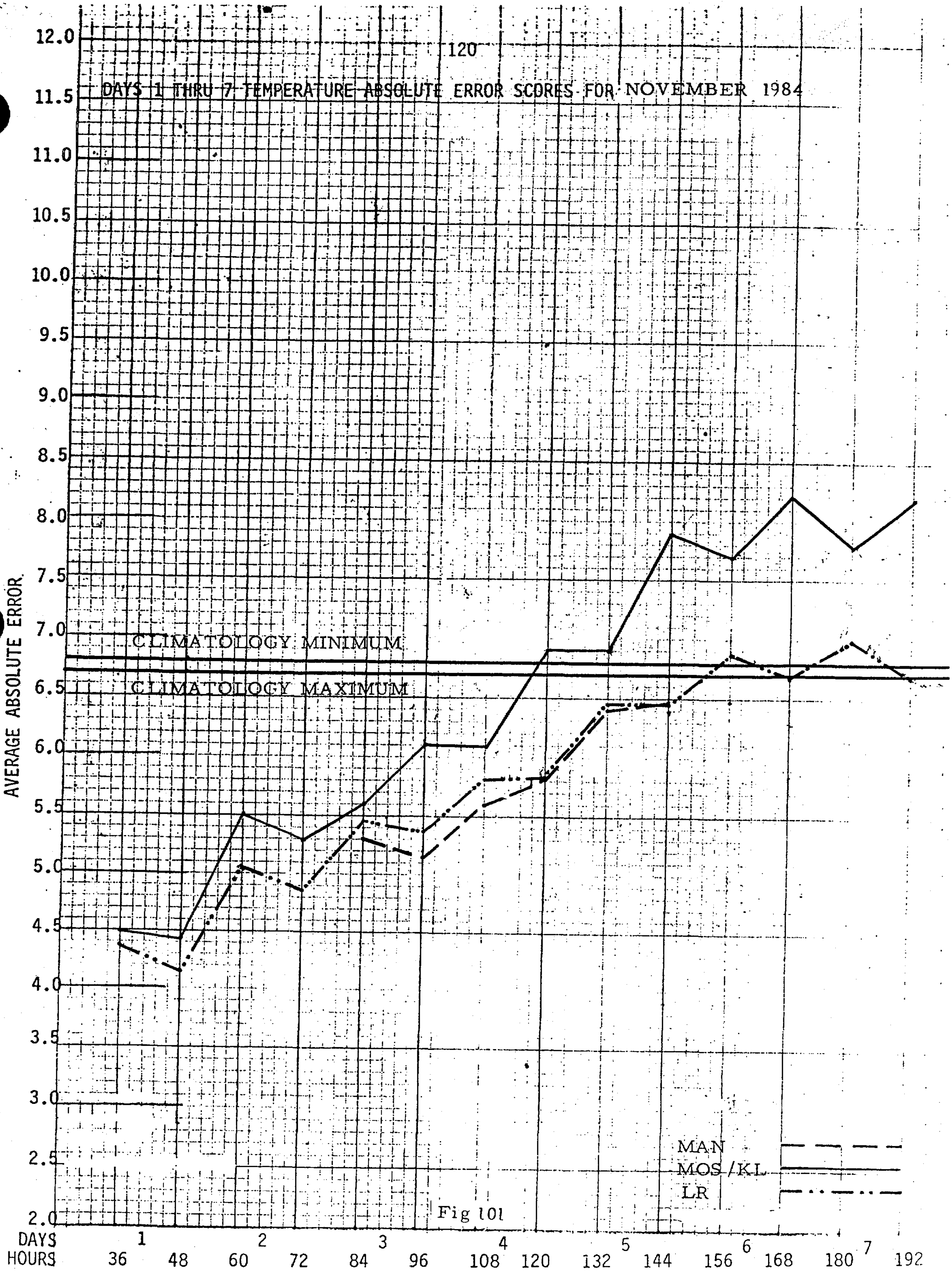
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 100


DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR NOVEMBER 1984
AVERAGE ABSOLUTE ERROR
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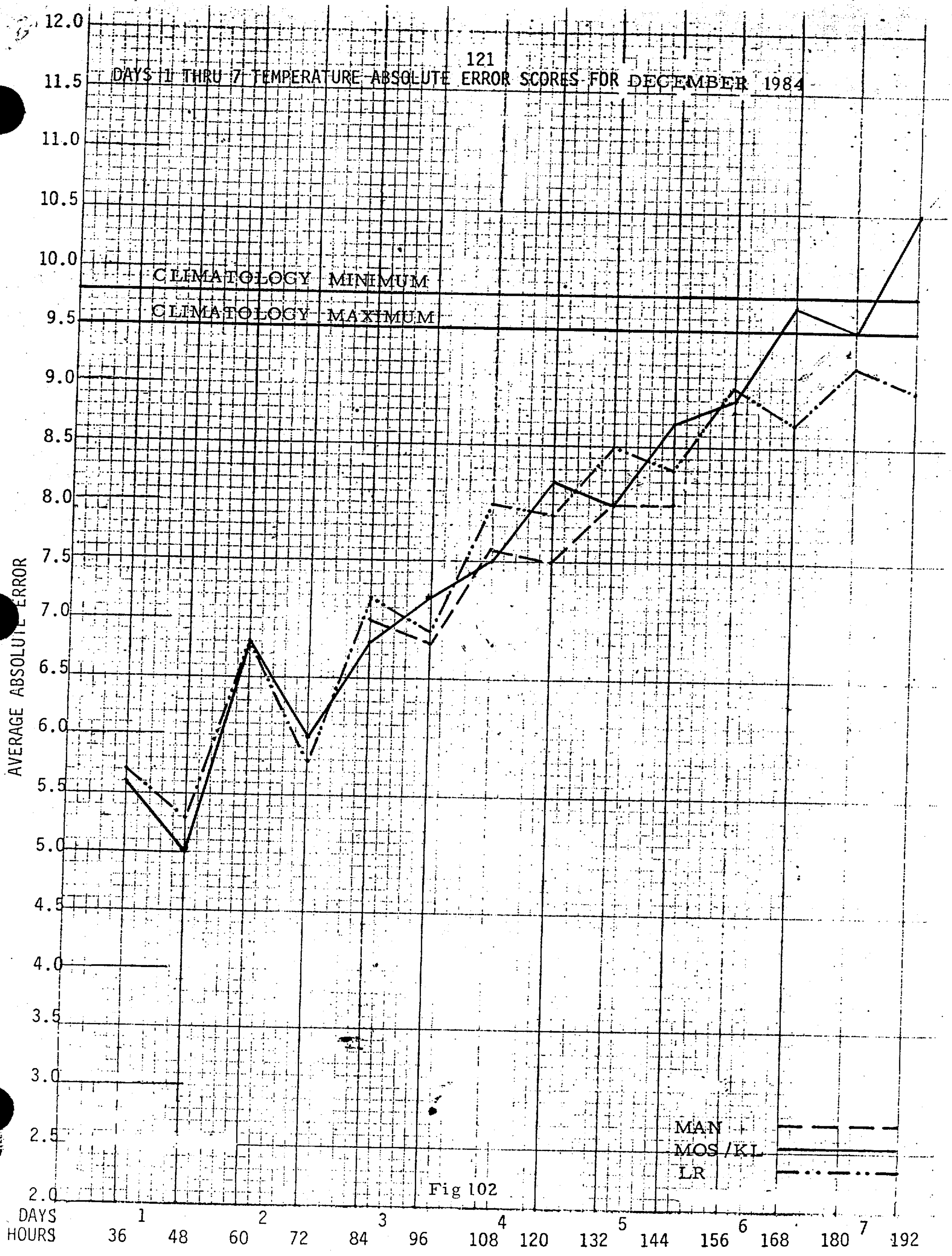
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
CLIMATOLOGY MINIMUM
CLIMATOLOGY MAXIMUM
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192
Fig 101


DAYS 1 THRU 7 TEMPERATURE ABSOLUTE ERROR SCORES FOR DECEMBER 1984
CLIMATOLOGY MINIMUM
CLIMATOLOGY MAXIMUM
AVERAGE ABSOLUTE ERROR
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11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
MAN
MOS/KL
LR
DAYS 1 2 3 4 5 6 7
HOURS 36 48 60 72 84 96 108 120 132 144 156 168 180 192

Fig 102

COMMENTS

SECTION 1 - MSLP & 500-MB CORRELATION SCORES PAGES 10 TO 32

The pattern correlation score (Appendix A) has been the basic score used by the MRFG to verify the MSLP and 500-MB progs since the start of the MRFG program. The correlation score was chosen because it is more sensitive to the phasing of troughs and ridges (considered to be more important) than to the depth or heighth of these systems. The MSLP and 500-MB operational analyses (HUF) were used to verify the forecast through 1976 and the LFM since 1977.

The North America (NA) standardized correlation score is the oldest score of record. The US subset unfortunately was contaminated from the beginning through 1975 by a coding (program) error affecting the observed field (verifying analysis).

It was assumed from the start that a MSLP standardized (anomalous field) score of greater than 0.0 (climatology) would result in the derived forecasts of temperature and precipitation having more skill than climatology (as a forecast). However, experience has indicated that a NA score of 0.17 or better is required to accomplish this.

Most of the forecasters complained from the beginning about verifying a forecast of the anomalous MSLP field (which they could not "see") instead of the one they produced (the actual MSLP field). In order to appease the forecaster and obtain a score for the normal (climatology) as a forecast the unstandardized (actual MSLP field) score was introduced in 1977 and has been used successfully ever since.

A glance at figures 2 through 22 shows that, for the most part, the monthly mean scores during 1984 were higher (better) than the long term mean scores (note - the long term mean includes the 1984 scores). Also a comparison of the current long term mean scores (figures 3,6,9,12,15,18, and 21) with those published in NMC ON 284 of February 1984, indicates an upward trend. The many monthly mean record scores (figures 2,5,8,11,14,17, and 20) set by both the man and NMC/NWP model guidance resulted in 1984 being a near record year for the days 3, 4, and 5 (figures 4,7,10,13,16,18, and 22).

No comment is made concerning the "betterment" of the man over the NMC/NWP model guidance except that it appears to be significant. No overall increase in skill of the guidance in the 1984 was apparent after the introduction of the Optimum Interpolation (OI) Analysis (see page 2). Since the scores for the circulation were near records, one might expect the derived forecasts of temperature and precipitation also to be near record levels.

SECTION 2 - TEMPERATURE ABSOLUTE ERROR & SKILL SCORES PAGES 33 TO 47

In 1984, as usual, the bi-monthly mean absolute error minimum (figure 24(a,b,c)) and maximum (figure 27(a,b,c)) temperature scores for the man exhibited a clear superiority over the KL and climatology temperature forecasts for days 3, 4, and 5. The man minimum (figure 26) temperature scores tied the all-time record for day 5 and were second best for days 3 and 4, while the maximum (figure 29) tied the record for days 3 and 4 and was second for day 5.

The man 6 to 10 day 5-class (figure 33) / 3-class (figure 36) temperature skill score was/tied a record in 1984 while the FP scores declined.

SECTION 3 - PRECIPITATION SKILL SCORES PAGES 56 TO 73

The Gilman skill score, except for the problem mentioned in Appendix C, is quite sensitive to correct forecasts of precipitation. The Hughes skill score is quite sensitive to correct forecasts of no precipitation at stations with a high climatic precipitation probability. The experimental score is quite sensitive to correct forecasts of precipitation at stations with a low climatic precipitation probability. Thus, these three scores complement one another.

In 1984, as in recent years, the monthly mean Gilman (figure 39), Hughes (figure 43), and Hughes Probability (figure 46) precipitation skill scores for the man showed a clear superiority over climatology and the NMC/NWP model on days 3, 4, and 5. The man Gilman precipitation skill scores (figure 41) were a record for days 4 and 5 and tied the record for day 3. The Hughes skill (figure 45) and probability (figure 48) scores, however, were not quite so record breaking. The monthly mean 3-class precipitation skill scores for the man 1 to 5 day (figure 51) and 6 to 10 day (figure 54) forecasts were modest in 1984.

SECTION 4 - MSLP, 500-MB & TEMPERATURE SCORES FOR DAYS 1 THROUGH 7 PAGES 74 TO 122

Certainly consideration has to be given, after looking at figures 55 through 102, to producing (operationally) for public consumption man MSLP and temperature forecasts for days 6 and 7. It should be noted that for comparison purposes (operational utility) the ECMWF scores have to be "backed down" approximately 12 hours.

CONCLUSION

In retrospect, 1984 turned out to be more of a "high plateau" year than a record breaker for the MRFG. 1985, promises to be an interesting year with the introduction in January, 1985 of the SMG4I with E-2 physics (radiation) and silhouette mountains.

ACKNOWLEDGEMENTS

Thanks to Mrs. Evelyn Seek and Mrs. Donna Thomas for their help with the typing and to Eric McVicker for running off copies.

Appendix A

The standardized mean sea level pressure correlation score is used to determine the skill of the man and machine days 3, 4 and 5 mean sea level pressure forecasts. The correlation score is employed because the phasing instead of the intensity of systems primarily determines how well the various weather parameters can be forecast. The standardizing procedure prevents the contribution of the high variability (higher latitude) grid points from overwhelming the low variability grid points (lower latitude).

f = forecast mean sea level pressure at a grid point

o = observed mean sea level pressure at a grid point

σ = standard deviation at a grid point

n = normal mean sea level pressure at a grid point

$$F = \frac{f-n}{\sigma} \qquad 0 = \frac{o-n}{\sigma}$$

$\overline{F}$ = average standardized forecast across n grid points

$\overline{0}$ = average standardized observed across n grid points

$$\text{RMS } F = \sqrt{\overline{F^2}} \qquad \text{RMS } 0 = \sqrt{\overline{0^2}}$$

$$\text{RMS Error} = \sqrt{\overline{(F-0)^2}}$$

$$\text{Average Absolute Error} = \overline{|F-0|}$$

$$\text{Correlation} = \frac{\overline{F0} - \overline{F}\ \overline{0}}{\sqrt{(\overline{F^2} - \overline{F}^2)\ (\overline{0^2} - \overline{0}^2)}} \quad X100$$

Since the normal mean sea level pressure is subtracted from the forecast/observed pressure at each grid point, it is assumed that the correlation of the normal to the observed is always zero. Therefore, any positive score is considered to have skill over the normal. Some doubts have been raised about this assumption, however, and for the past 5 years the unstandardized correlation score also has been calculated. This procedure allows a correlation score to be computed for the normal. This score then is simply the correlation of the forecast to the observed mean sea level pressure.

APPENDIX B

The 5 day mean temperature skill score is a generalization of the Heidke skill score where the expected values are derived from the observed temperature

$$\text{Heidke Skill} = \frac{C-E}{N-E}$$

C = total correct (hits)
N = total number of forecasts (61)
E = expected number of hits

The expected value is calculated as follows from the number of stations in each of the observed temperature categories:

$$E = 1/8 \times \text{Much Below} + 1/8 \times \text{Much Above} + 1/4 \times \text{Below} + 1/4 \times \text{Above} + 1/4 \times \text{Normal}$$

The 5 day mean 3 class temperature skill score simply "lumps" together the much below with the below and the much above with the above. The expected (E) then is equal to 1/4 X Below + 1/4 X Normal + 1/4 Above.

Appendix C

The Gilman skill score is a generalization of the Heidke skill score where the expected values are derived from a randomized version of the precipitation forecast.

Heidke Skill = $\frac{C-E}{N-E}$

C = total correct (hits)

N = total number of forecasts (100)

E = expected number of hits

However, for a randomized forecast allowance must be made for stations having far different precipitation climate (N POP) across the United States. Therefore, to compute and score an expected chance forecast, climatology must be considered. The procedure for this is as follows:

First, the actual number of forecasts of precipitation are distributed randomly taking into account station climatology. The expected number of chance hits is then given by:

$$E = \sum^{N} (p_i r_i + (1 - p_i)(1 - r_i)) \text{ or}$$

$$E = 2\sum^{N} p_i r_i + N - \sum^{N} p_i - \sum^{N} r_i \quad (a)$$

where $r_i = 1$ for precipitation ($\geq$.01 inch) and 0 for no precipitaiton ($<$.01 inch). Now an expression for p_i, which is the probability that after the forecast precipitation events are redistributed randomly a forecast precipitation event will fall at point "i" is given approximately by $p_i \cong F\frac{a_i}{\sum^{N} a_i}$ (b). Here F = total number of forecasted precipitation events and a_i = climatic precipitation probability (N POP). This approximate value for p_i is most valid for small values of F and $(a_i / \sum a_i)$ and is unstable at times. Because of this instability the less sophisticated but more stable Hughes skill score was developed.

Substituting the expression (b) into (a) gives $E = \frac{2F\sum^{N} a_i r_i}{\sum^{N} a_i} + N-F-R$, where E = the approximate expected value of a randomized forecast, R = total precipitation cases, and N = total number of stations. If the climatic probabilities are uniform ($a_i = a_j = a$), then the approximate value of E reduces to the standard Heidke value given by: $E = \frac{(N-F)(N-R)+FR}{N}$.

Appendix D

The Hughes skill score is a generalization of the Heidke skill score where the expected values are derived from the observed precipitation:

$$\text{Heidke Skill} = \frac{C-E}{N-E}$$

C = total correct (hits)
N = total number of forecasts (100)
E = expected number of hits

If the average precipitation climate (NPOP) of 12 stations having precipitation is 25, then the expected (precipitation) is simply 12 x .25 or 3 stations. If the average NPOP of the (100-12) stations not having precipitation is also 25 then the expected (no precipitation) is simply 88 x (1.0-.25) or 66 stations. The total expected (E) then is 69 stations. If the forecaster hit (C) 75 stations correctly, his skill score then is (75-69)/(100-69) x 100 or 19.

APPENDIX E

The (Hughes) probability score is not a skill score yet it is quite simple to understand. A rough score (RS) is calculated for each station (N=1 to 100) as follows:

Forecast	Observed	RS
(DN POP + NPOP) ≥30	P=1	+(1 - NPOP)
(DN POP + NPOP) ≥30	P=0 and NPOP ≥50	-(NPOP)
(DN POP + NPOP) <30	P=1 and NPOP ≥50	-(NPOP)
(DN POP + NPOP) ≥30	P=0 and NPOP <50	-(1 - NPOP)
(DN POP + NPOP) <30	P=1 and NPOP <50	-(1 - NPOP)
(DN POP + NPOP) <30	P=0	+(NPOP)

Since the total rough score (TRS) for the 100 stations does not equal 100 points, a simple iterative technique is employed which uses the RS as a f(NPOP) for each station to bring the total number of points up to 100. The FORTRAN language routine is:

```
              TTY = 0
   70         DO 69   I = 1, 100
              TRS = (100.0 - TRS) * ABS(RS(I)) * .01
              IF(RS(I)) 73, 74, 74
   73         RS(I) = RS(I) - TRS
              GO TO 69
   74         RS(I) = RS(I) + TRS
   69         TTY = TTY + ABS(RS(I))
              TRS = TTY
              TTY = 0.0
              IF (TRS - 99.8) 70, 71, 71
   71         CONTINUE
```

APPENDIX F

The 5-Day mean precipitation skill score is a generalization of the Heidke skill score where the expected values are derived from the observed precipitation:

$$\text{Heidke Skill} = \frac{C-E}{N-E}$$

C = total correct (hits)
N = total number of forecasts (100)
E = expected number of hits

For example, in January the number of stations in the area covered by the (NP/P), (NP/M/H) and (L/M/H) categories is 21, 28 and 51 respectively. The average value of the probability of NP for the stations in the (NP/P) area is 59% and 40% in the (NP/M/H) area. Now if (NP/L) is coded as 1, M as 2 and (P/H) as 3, then the number of stations expected to have coded value 1 thru 3 is as follows:

33% of (L/M/H) = 51 x .33 = 17 stations coded 1, 2, 3

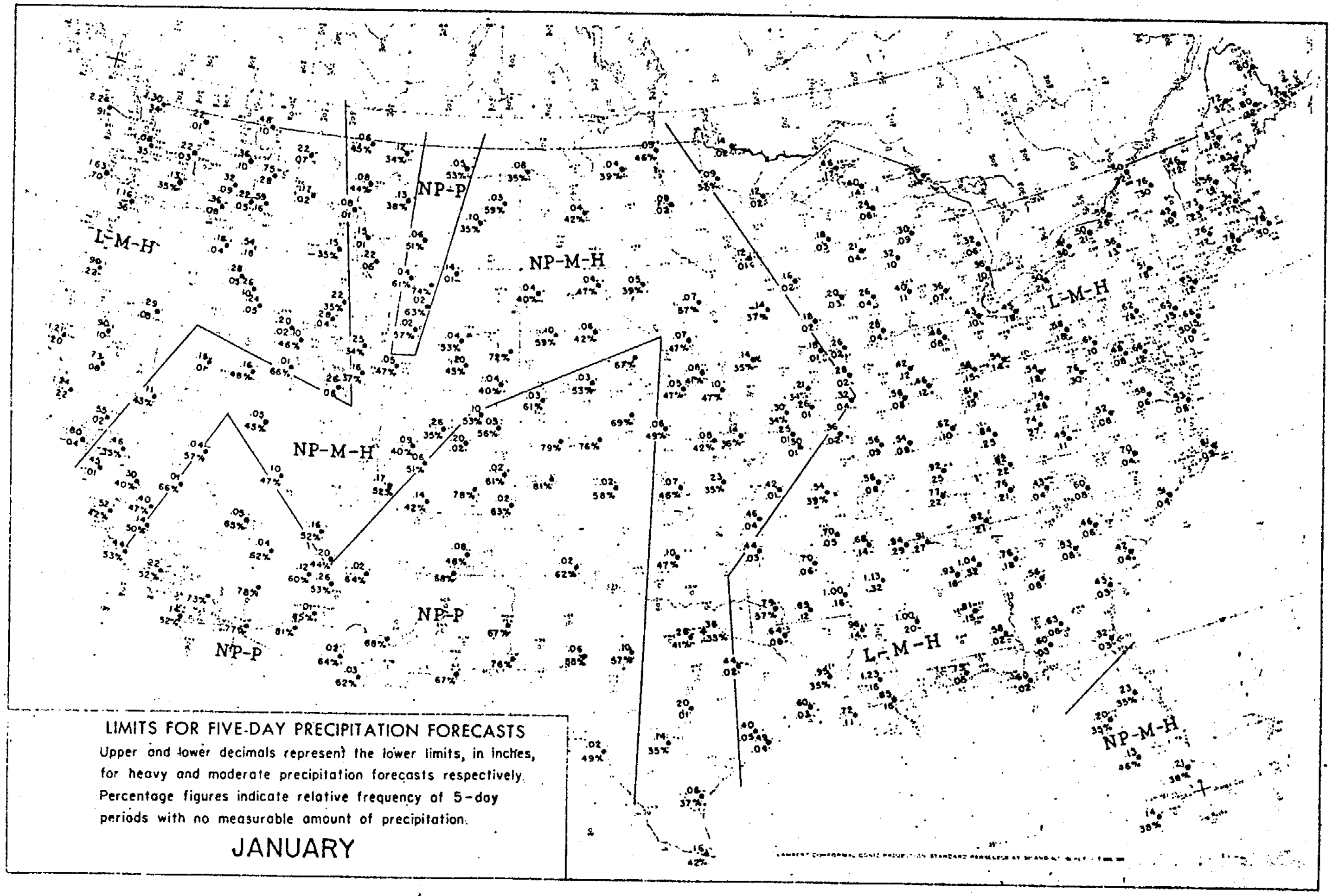
40% of (NP/M/H) = 28 x .40 = 11 stations coded as 1 and 8.5 coded as 2,3

59% of (NP/P) = 21 x .59 = 12 stations coded as 1 and 9 coded as 3

$$\begin{aligned}\text{Thus, code } 1 &= 17 + 11 + 12 = 40 \text{ stations}\\ \text{code } 2 &= 17 + 8.5 = 25.5 \text{ stations}\\ \text{code } 3 &= 17 + 8.5 + 9 = \underline{34.5} \text{ stations}\\ & \qquad 100.0 \text{ stations}\end{aligned}$$

Therefore, the expected value = .40a + .255b + .345c

where a, b and c are the number of coded values 1, 2 and 3 observed.



LIMITS FOR FIVE-DAY PRECIPITATION FORECASTS

Upper and lower decimals represent the lower limits, in inches, for heavy and moderate precipitation forecasts respectively. Percentage figures indicate relative frequency of 5-day periods with no measurable amount of precipitation.

JANUARY