MAGREF; Some Guidelines, Comparisons and Programs for Reference Magnetic Fields

by

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Internal Report

1984-5 (G)

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Summary

A new method, including programs, to determine extremely quiet reference levels for the separation of magnetic field observations into internal and external fields is described. The method uses the global magnetic indices (AE, Kp and Dst), visual examination and filtering of the magnetic observations to determine very quiet nighttime levels; such levels have very small perturbations due to the external sources. A regression analysis of a number of these levels, which are determined over a year or more, is made to ascertain the undisturbed reference level and the secular variation. This reference level can be used for the calculation of the perturbations of external sources, while its secular variation can be used for studies of the internal field. This reference level and secular variation are compared with those that might be determined from the quiet and all day means. The programs are written in CDC Fortran 5 (Fortran 77) and can readily be modified for other computer systems.

Introduction

The magnetic field of the earth is continuously changing due to dynamic external sources and slowly varying internal sources. The accurate separation and modelling of these sources is an important goal of geophysics. A method is outlined to determine the very quiet nighttime level when all known external sources are minimal and consequently their magnetic fields are small. From an extended series of these quiet levels, the undisturbed level and the secular variation of the internal field can then be determined. This undisturbed level is also ideal for the reference for obtaining perturbations due to external sources. The procedures are outlined and the programs are documented.

The increasing demands for improved delineation and modelling of both the internal and external magnetic fields and their sources and variations require a quantitative method for separating the fields. Refined modelling techniques and improved observations during surveys and campaigns require reference levels with accuracies of a few nanotesla. Because of the few extremely quiet nights in high latitude regions, which are necessary for the analysis, the instrument must be stable over an extended period. This requirement is met at observatories where absolute measurements are frequently made, and undisturbed levels can be determined with accuracies of ~5 nT (Walker, 1982; Campbell, 1980). The method might also be used with extended good variation data to determine the undisturbed levels for selected intervals. However, this accuracy may not be possible at such temporary stations as there are sometimes drifts due to instrumental, sensor and pier changes.

The method and analysis of the data for obtaining the quiet nighttime levels are discussed in the next section. This is followed by the method for the determination of the undisturbed reference level. These reference models are then compared with those that might be determined from the quiet and all day means to ascertain if they are significantly different. The last section briefly discusses some applications and programs for plotting magnetograms with the undisturbed reference level and the secular variation. The programs are listed in the appendix and the general procedure is shown in Fig. 1. Many of the subroutines were developed in-house or modified from other general purpose algorithms.

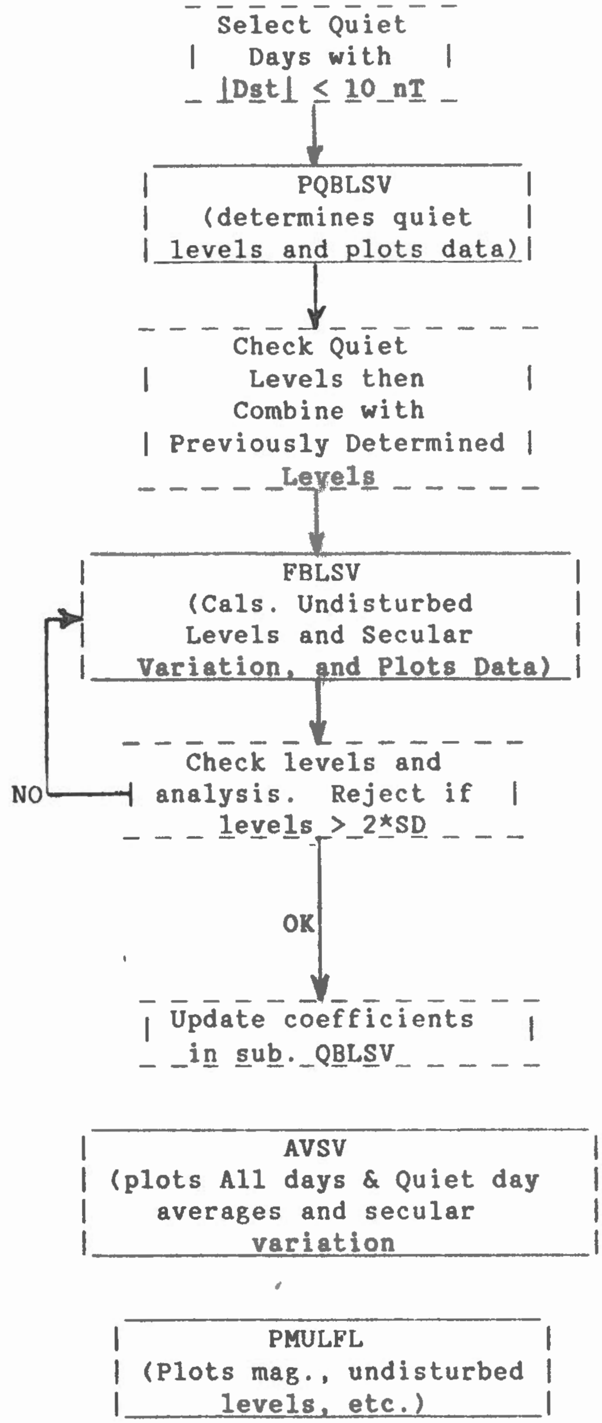

Fig. 1 Flow diagram for the selection of quiet levels, determination of the undisturbed levels and plotting of standard magnetograms with these levels.

Quiet Nighttime Levels

The separation of external and internal magnetic fields by selective sampling and filtering requires some understanding of the characteristics of each source. External sources are known to have short term variations with periods from seconds to a few days which are superimposed on semiannual, annual, 11 and the 22 yr Hale solar variations. Internal sources have long-term undulations and also possibly 11 and 3 yr variations. These periodic long-term variations cannot be readily separated, but with knowledge of the nature of the external source, samples can be taken when the external fields are minimal. These samples can then be further analyzed to reduce the effects of some external sources. The following procedure can be used to determine the quiet levels for the preliminary separation.

(1) The initial selection of quiet nighttime intervals is made by a visual inspection of an extended series of the magnetograms. Generally, there are a few quiet intervals (Fig. 2a) associated with each 27 day solar cycle, which are suitable for further computer analysis. However, during the 2 or 3 years of, and for a couple of years after, the solar cycle maximum, the magnetic activity in high latitude regions is often significant for several months. At such times it may be necessary to span two or three months before an acceptably quiet interval can be obtained. While these quiet nights may contain some disturbance which can be filtered, they should also have a few quiet hours when the activity is very low (i.e. maximum perturbation $\leq$ 10 nT).

(2) The daytime must be avoided as the sunlit ionosphere is highly conductive at such times, which generally results in significant currents

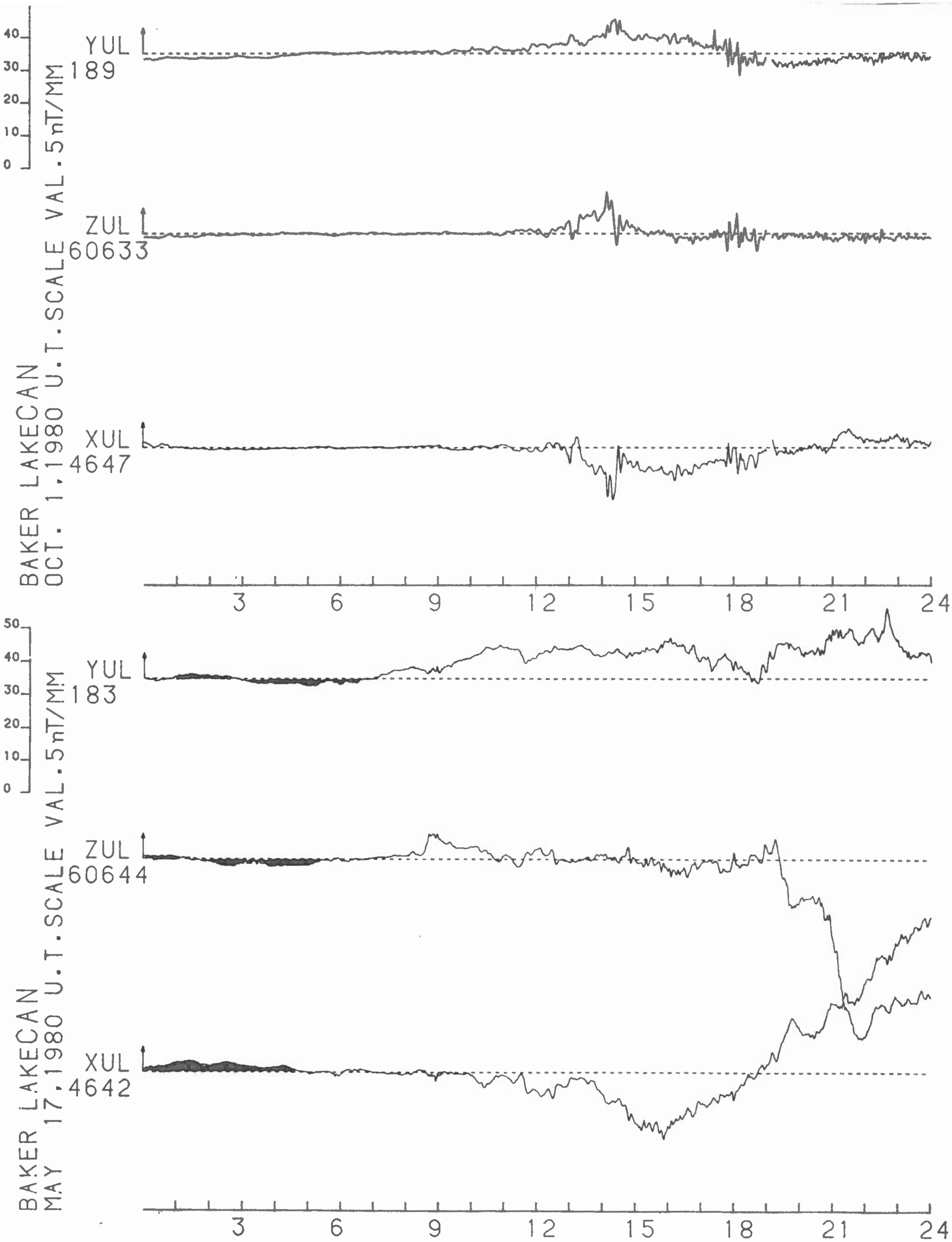

Fig. 2 Typical high latitude magnetograms during quiet (a) and moderately quiet (b) conditions. The undisturbed levels are indicated by the dashed line, while the shaded region (b: x comp.) indicates the eastward electrojet.

and hence magnetic perturbations. During the summer high latitude stations are continuously sunlit or have a short night, and consequently are rejected by the program. During the late spring and early fall periods, when middle and high latitude stations have short nights, the nighttime interval is automatically reduced from 6 h to 4 h.

(3) Slowly varying external sources, such as ring currents, cannot be readily identified by visual inspection of magnetograms. Magnetic indices can be used to determine intervals when these currents are minimal and to optimize the selection of quiet intervals. The AE index (Mayaud, 1980) is derived from the maximum positive (AU) and the most negative (AL) disturbances in the auroral zone. An index which is greater than ~100 nT will probably be associated with asymmetric field-aligned currents. These could cause perturbations of ~10 nT over a large region and hence such disturbances should be avoided. Similarly, the Kp index, which indicates disturbances in mid-latitudes, can be used as a guide for selecting quiet intervals. Nighttime intervals should be avoided when Kp is greater than ~1+. The Dst index is an indication of ring currents which can cause disturbance over the entire earth. This index represents the average magnitude of the disturbance at low latitudes, while at high latitudes, disturbances due to ring currents may typically be half the value of the index. Thus intervals when |Dst| is greater than ~10 nT should be avoided. These indices are published in the IAGA Bulletin No. 38, while the Kp index is also published in the Journal of Geophysical Research.

The maximum values adopted at any time, for these indices are subjective and will vary for each station, depending on its latitude and the solar activity. Obviously, too stringent limits on the indices and visual selection criteria will result in too few, quiet, nighttime intervals. It is desirable to have values at least every 3 months or so in order to ensure that the observations are consistent and to determine the secular and any annual variations. A few intervals, when |Dst| may range to 15 nT, may be required for some high latitude stations during long stormy periods. For routine operation, these extremely quiet intervals might be selected in conjunction with the 5 quiet monthly days, which are of similar character.

(4) Finally, the filtering and standard deviation rejection criterion can be adjusted in the program. For high latitude stations low pass filtering with a cutoff at 2 or 3 hours is preferable. This might be extended to ~4 hours for mid and low latitude stations. Nighttime intervals are rejected if the standard deviation of the filtered data during the interval is greater than 15 nT for stations above 45° latitude. For stations below 45° this rejection level is 8 nT.

The program, PQBLSV - preliminary quiet baselines and secular variation (Appendix A), first initializes the filter coefficients and other parameters, then successively reads the previously selected quiet days from cards and searches the tape for these days. The format for the data is that of the Earth Physics Branch's 1 min observatory data, but it could be readily modified for other data formats. The program then (1) determines the local nighttime interval from the station code, (2) checks for missing data, (3) calculates the daily average and its standard deviation, and (4) filters the data. Subsequently the nighttime average and standard deviation are determined and checked against the

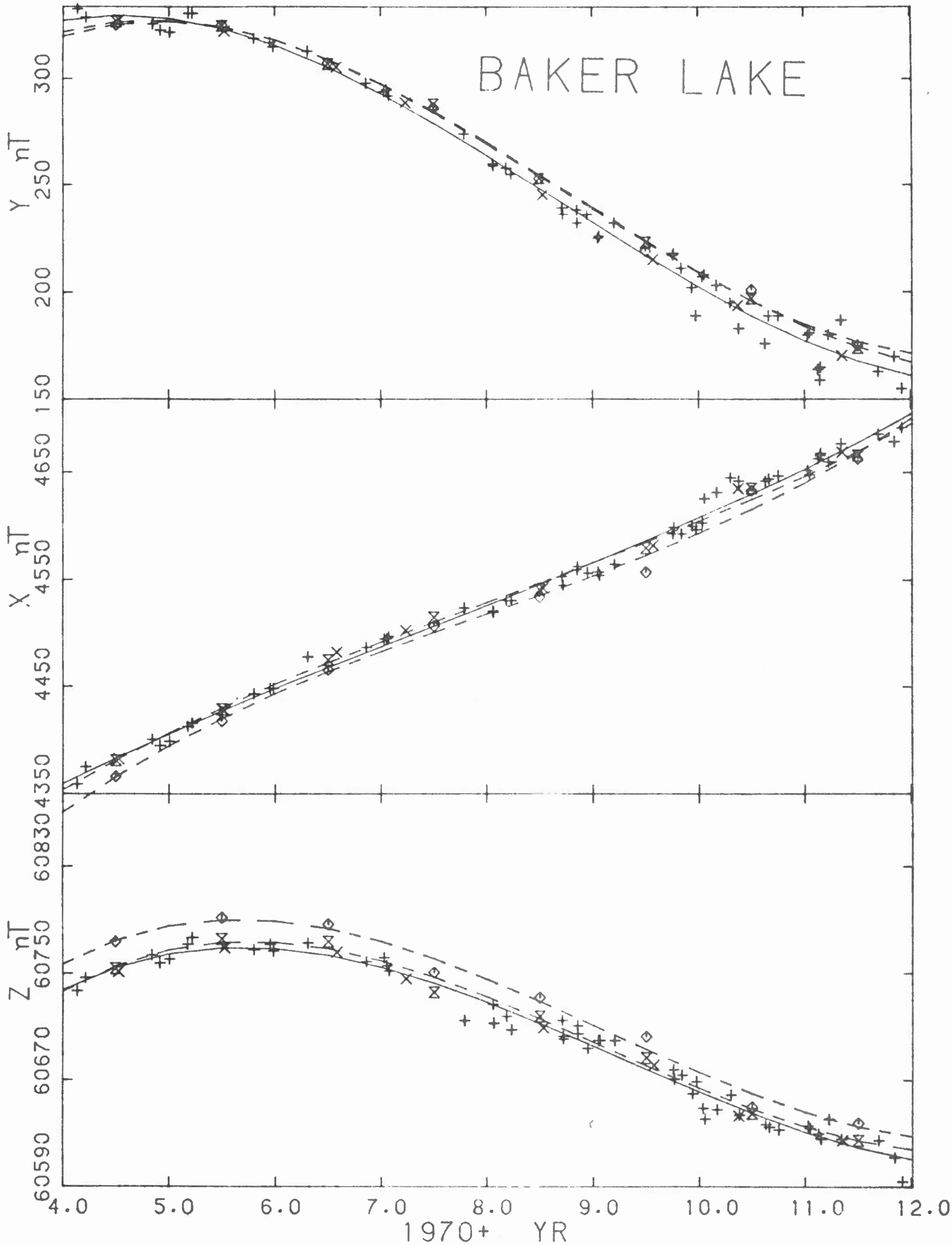

Fig. 3 The quiet nighttime levels (+), all day (◇) and quiet day (⧖) annual means, and the regression analyses for the undisturbed reference field (solid curve) and others are indicated for each of the components.

rejection criteria. A weight proportional to the inverse of the standard deviation is assigned to this average. Finally, the data and the quiet nighttime levels are plotted for further visual checks (Figs. 2a and 2b). This process is repeated for all the quiet days selected for analysis. The program presently accommodates 97 selected quiet days, over 4 years, from one station or up to 4 different stations, each of a year's data. The daily and nighttime averages, standard deviations, maximum and minimum values are all listed. The station name, latitude, longitude, date and quiet nighttime level (average) are also put out on cards in the IAGA format for repeat stations (see statement 300 of PQBLSV for details). These are subsequently used as input for the final analysis of the reference level and secular variation in the next program. However, the last segment of the PQBLSV program also performs a linear regression analysis in the EMR subroutine ACS015. This routine determines the preliminary undisturbed reference levels and the secular variations which are then plotted with the weights using the subroutine XYLGPL (similar to Fig. 3).

Reference Levels and Secular Variation

The quiet nighttime levels calculated from the previous program need further checking to eliminate any erratic values and to determine any irregular characteristics in the levels. The following outlines how the nighttime levels are first visually checked for consistency with the observations, then with each other, and finally on an annual basis.

Occasionally, very quiet intervals will occur during the late evening to midnight interval, while substorms generally occur from premidnight to the

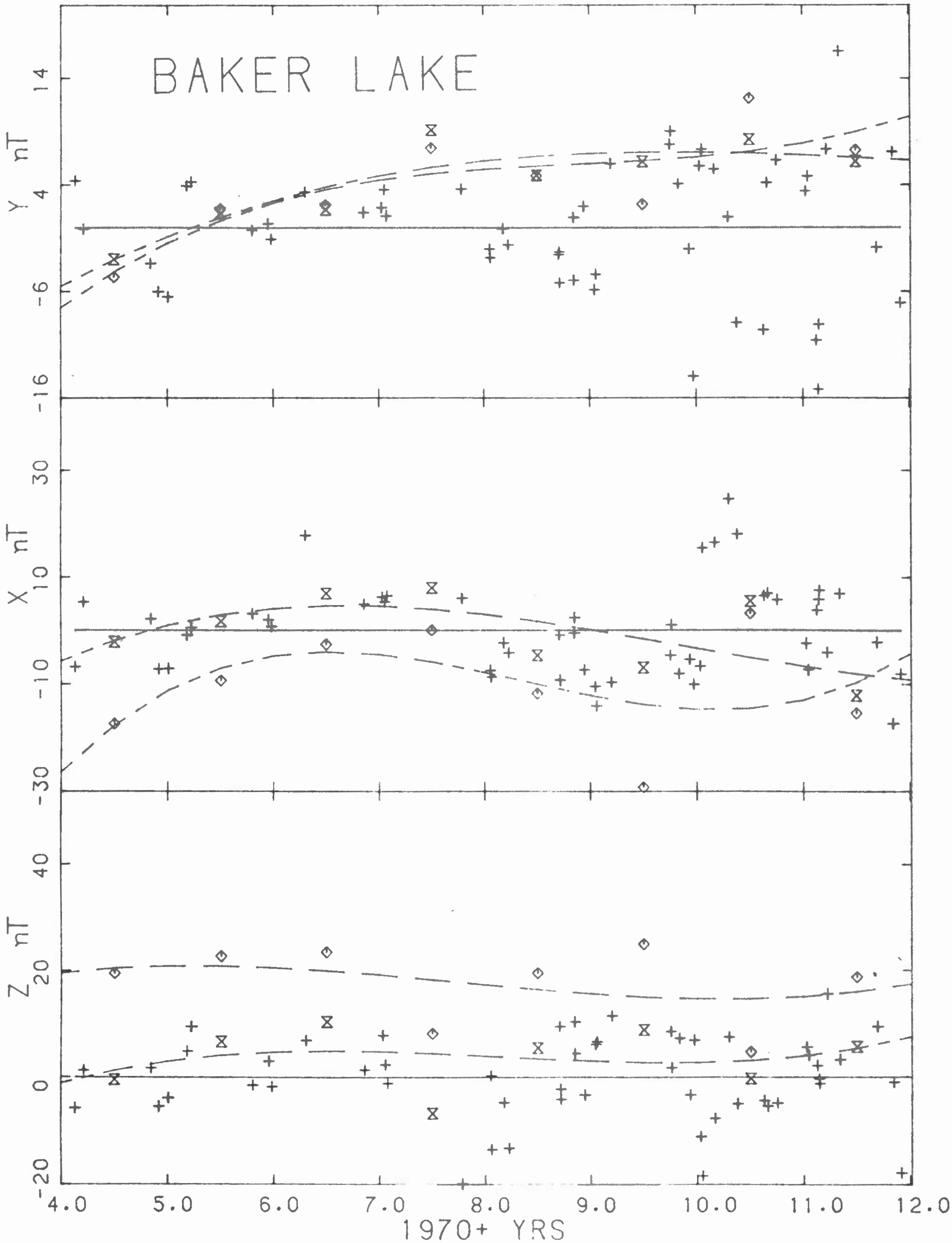

Fig. 4 The quiet nighttime levels (+), all day (◇), and quiet day (⧖) annual means with the main undisturbed reference field removed.

early morning. The plots of the observations and quiet nighttime levels made in the previous program are visually checked to ensure the computed levels are consistent with these exceptionally quiet periods. However, in high latitude regions an eastward convection electrojet also occurs at times in the premidnight sector, which is characterized by a slow increase in the field (shaded sections of X, Y and Z components, Fig. 2b). This perturbation is often only a few nanotesla and it is sometimes difficult to identify. Generally, if the computed quiet level is within 5-10 nT of these exceptionally quiet levels in the magnetogram it is acceptable, otherwise the day should be rejected. These computed levels might be manually corrected to that of these exceptionally quiet intervals for sparse periods of data, if it is obvious they have been offset by substorm activity.

The computed quiet levels are used for a preliminary regression analysis (FBLSV, Appendix B) of the data. A stepwise regression analysis is best as it allows determination of the optimum coefficients for the model (i.e., IMSL's RLSEP). From a plot of these levels and of the quadratic function, a second check can be made for self consistency of the levels. Those levels, which have passed the previous test and are still more than twice the standard deviation from the regression curve, should be rechecked for possible errors and if erroneous they should be rejected. Such errors might be instrumental or they may occur in the referencing of the observations to the absolute determinations or they might also be due to some unusual external or environmental sources. Systematic steps or offsets of several adjacent quiet levels from the long term trend probably indicate an environmental (magnetic) change, which should then be investigated and removed if possible.

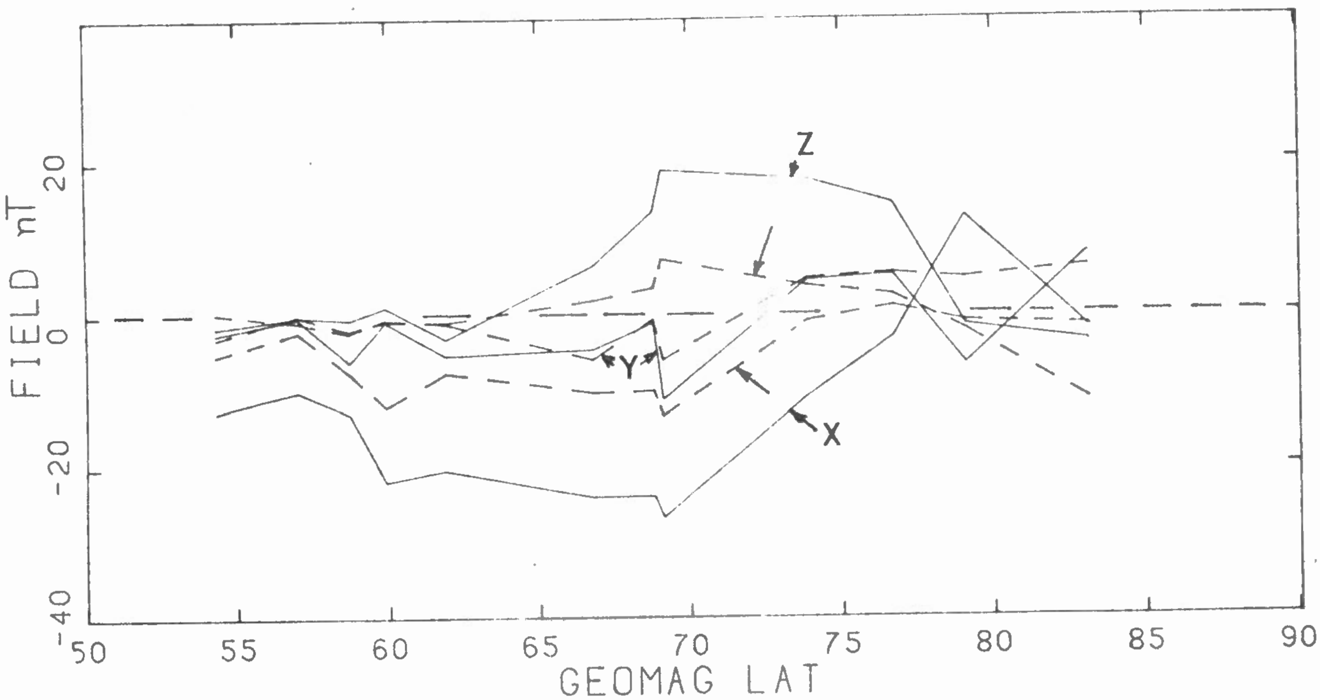

Fig. 5 The average of the differences of the all day (solid curves) and quiet day (dashed curves) annual means from the reference levels for 13 Canadian observatories.

The second program, FBLSV, combines these new quiet nighttime levels with those from previous analyses of earlier data to determine the final undisturbed reference levels. An analysis is made of all the quiet levels, and those which are erratic or deviate from the new reference level by more than twice the standard deviation are rejected and the analysis is repeated until the standard deviation is similar to the expected error ($\leq$ 10 nT). The quiet nighttime levels are also plotted with the new reference level removed in order to reveal any systematic variations in the levels. They are also plotted on a superposed epoch (annual) basis for a visual analysis of the levels and a quadratic fit (regression analysis) is made to determine any seasonal variations (Campbell, 1983).

The program reads the card output from the previous program, PQBLSV, which has been culled by the above procedure for extraneous quiet levels. These levels are compared with annual (all day) and quiet day means which are also read from cards and listed with the quiet levels. An analysis is then made of each component and other statistical parameters are also determined and listed using the subroutine ACS015. The quiet levels, annual means, and the reference level (regression curve) are subsequently plotted for each component (Fig. 3). The differences of the quiet levels and the annual means from the reference levels is then determined and plotted (Fig. 4). The average of the difference of the all day and quiet day annual means are put on cards for subsequent analysis of the net external current systems. The program, AVSV (Appendix C) plots these differences (Fig. 5) and the secular variation (Fig. 6) from the updated subroutine QBLSV. The reference levels for the middle of the year are determined and also put on cards for secular variation studies and the updating of earlier surveys. Finally, the

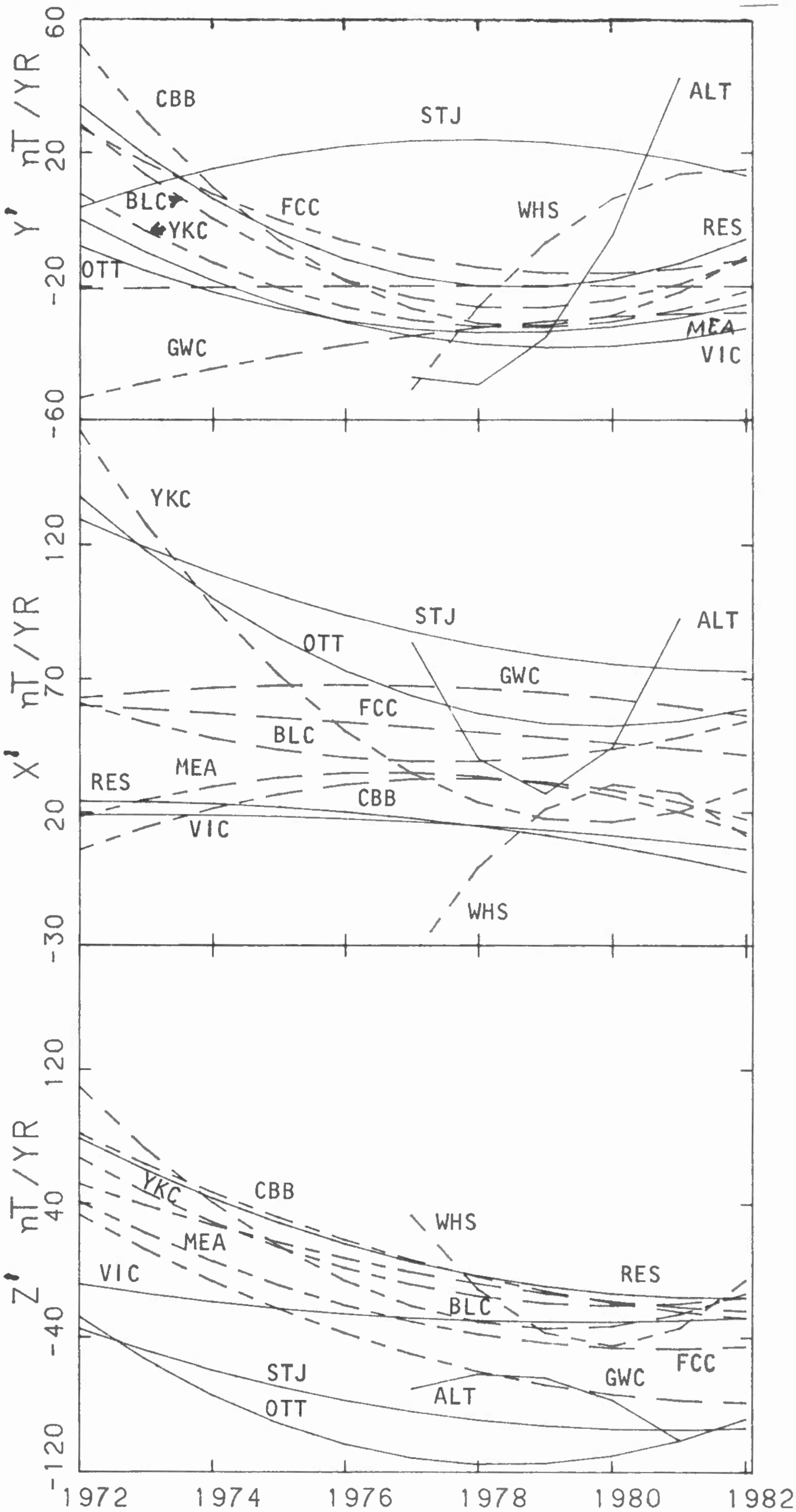

Fig. 6 The X, Y and Z secular variations for the Canadian observatories for the period 1972-82.

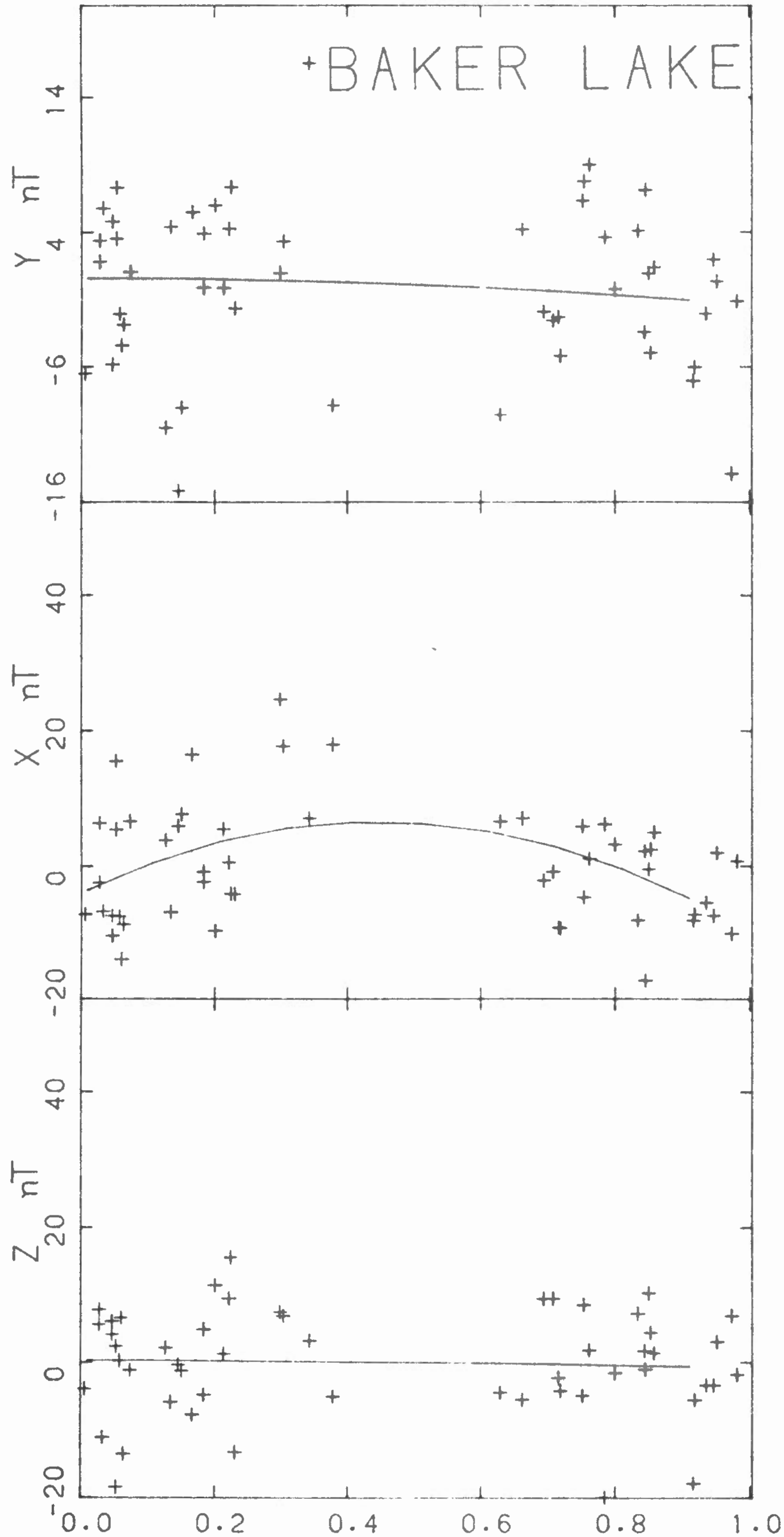

Fig. 7 The quiet nighttime levels (+) plotted on a superposed epoch (annual) basis and the quadratic regression analysis (solid curve).

differences of the quiet levels from the reference level are combined for a superposed annual epoch analysis. Such annual variations may be due to external sources (Campbell, 1983) or instrumental. A quadratic regression analysis is made of these values and both the levels and the regression curve are plotted (Fig. 7). Note, only the X component has a significant variation. The coefficients of the analysis and the statistical parameters are also listed.

Comparisons of Reference Levels and Secular Variations

Data from some observatories are thought to have errors of 5-10 nT due to various instrumental and calibration errors and reduction procedures. Because of these errors and those in the determination of a quiet nighttime field, is this latter significantly different from that of say the quiet day means? The statistical F ratio tests can be used to determine if two functions calculated from two independent but similar data sets are different. However, such tests do not per se determine which curve or method is the best. This test is also used to determine if the secular variations calculated from the annual mean differences of the nighttime, quiet day or the annual means are significantly different.

A rigorous test of a fitted equation is cross verification of a second similar data set. The procedure is to fit regression curves to each data set and to the combined data sets and determine the residuals (Daniel and Wood, 1979). The F ratio is determined from the sums of squares of the residuals of the combined sets (A) minus those of each individual set (B and C) to the sum of the two data sets. The numerator is reduced by the number of variables (p) while the denominator is divided by the combined number of observations $(n+\ell)$ minus twice the number of variables (2p).

$$F = \frac{\dfrac{A-B-C}{p}}{\dfrac{B+C}{n+\ell-2p}}$$

The regression analysis and the residual sums of squares can be determined from standard routines such as EMR's ACS014 and ACS015 (see Appendix A) and the IMSL algorithms RLSEP, RLMUL or RLSEP. The $F\ (p, n+\ell-2p)$ value at the 95% confidence level for a quadratic function with about 50 combined observations is ~2.8. Thus, if the calculated ratio is greater than this F value the data sets are significantly different.

The quiet nighttime levels were compared with the quiet day and all day annual means for 10 Canadian observatories. Generally, a quadratic function was used, but a few components required only a linear function while for some others a cubic function could be used (Fig. 4, dashed curves). The F ratio comparisons for each of the three components for the period from about 1974 to 1981 for these observatories are listed in Table 1. Those that are significantly different are indicated by an asterik (*).

At subauroral latitudes (VIC and OTT) only the X component is significantly different while in the auroral zone (GWC, FCC, YKC and BLC), sometimes both the X and the Z components are different (also see Fig. 5). These subauroral differences are expected as the quiet day and all day means average in the Sq and Dst effects which are largest in the X component. In the auroral zone both the X and Z components are frequently perturbed by magnetic substorms, while the Y component is affected primarily by the smaller perturbation of the more remote field-aligned currents. The Y and Z differences in the polar cap (CBB and RES) are probably due to the perturbation of more moderate substorms and cleft current systems. Comparison of the reference level with the quiet day level is better, nevertheless, generally one component is significantly different. Thus, as the quiet nighttime reference levels are physically more representative of an ideal reference and are generally significantly different from ones that might be determined from the quiet or all day means, it is concluded that they could be used for references.

The secular variation is traditionally determined from the difference of the annual means but it could also be obtained from the quiet day or the quiet nighttime annual means. The solar cycle may contribute variations of ~10 nT to the annual means and ~5 nT to the quiet day means, while the nighttime levels have standard deviations of 4-9 nT. The secular variation was determined for the three data sets and then they were compared to ascertain if there was any significant differences. Regression curves were determined for each set (Fig. 8) and for the combined sets. The same F ratio test was used as for the references levels but because of the smaller data sets (~10 samples) the 90% level is used for which the significance is ~2.5. The F ratios for the observatories are listed in Table 1 and it can be seen that, while the quiet day values are generally less than the all day values, they are all less than 2.5.

The secular variation was also determined by differentiating the regression curve obtained directly from the nighttime levels (Fig. 8). This SV curve was generally consistent with those determined by the difference method. However, in a few instances the curve obtained by differentiating indicated a different trend or curvature than those obtained by the difference method (Fig. 8, X component). This may be due to the longer series of data (~2 yrs) for the nighttime levels than for the annual mean differences which constrains it more than the means.

The average standard deviation of the regression curves for each component (Table 2) was also determined for an indication of the variation in the data sets. The nighttime and quiet day values are comparable, but the standard deviation for the X and Z components of the all day means are slightly greater than the others. Thus, it is concluded that either the annual, quiet day or quiet nighttime values could be used for secular variation studies, but that the quiet day values appear slightly more consistent.

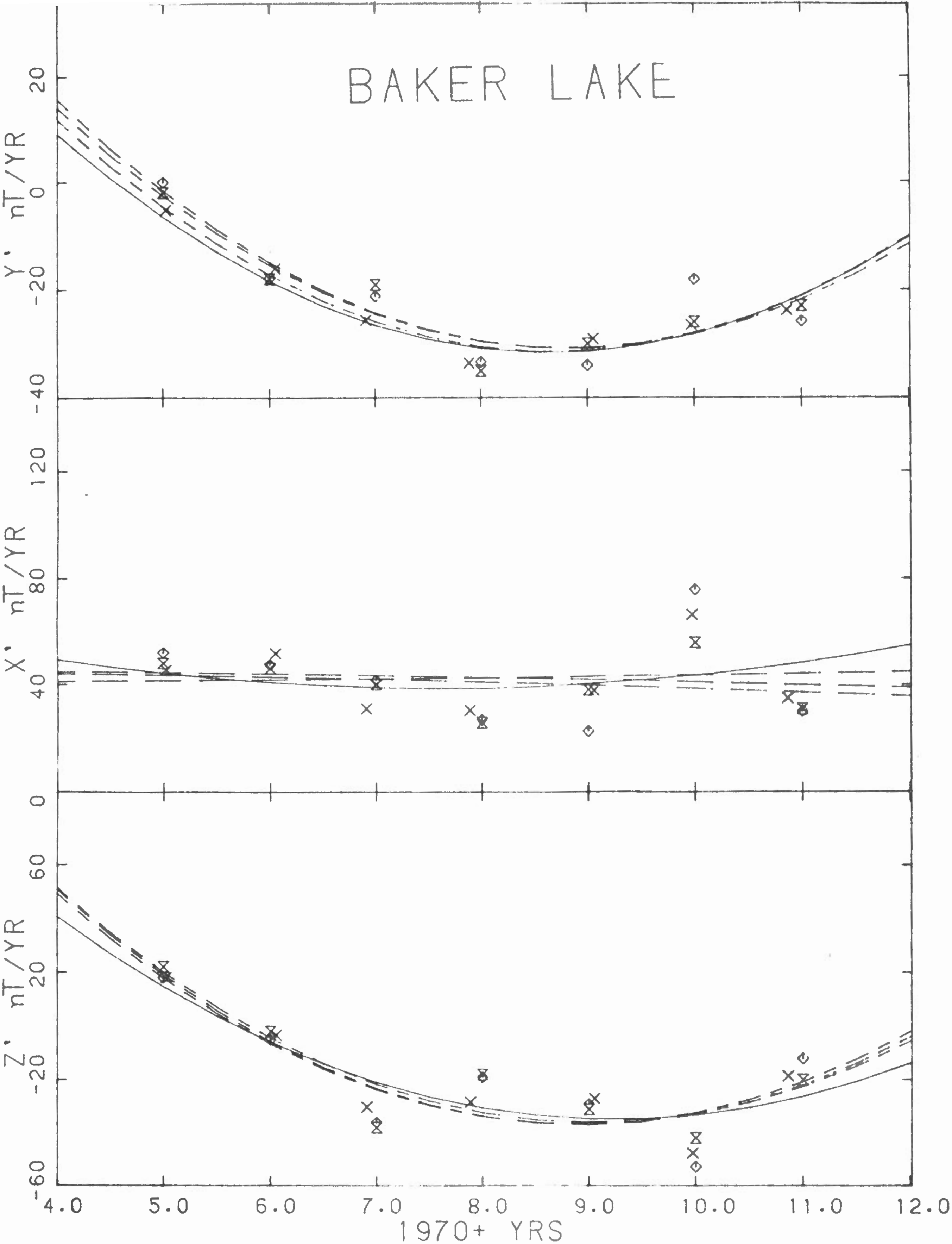

Fig. 8 The annual mean differences for the quiet nighttime (X), quiet day (⧖) and all day (◇) means and their models (dashed curves). The secular variation determined by differentiating the reference nighttime model is also shown (solid curve).

TABLE 1

F Comparisons of References and Secular Variations

Station	Component	References: Quiet Day	References: All Day	Secular Variations: Quiet Day	Secular Variations: All Day
	X	3.6*	16.0*	.15	.14
VIC	Y	.2	1.1	.09	.27
	Z	1.1	.7	.72	.36
	X	2.4	7.3*	.26	.70
OTT	Y	.5	.5	.01	.02
	Z	.2	.2	.15	.10
	X	3.1*	7.8*	.01	.02
STJ	Y	1.0	7.3*	.29	.60
	Z	.8	.5	.11	.17
	X	3.8*	19.2*	.06	.04
MEA	Y	.4	2.5	.49	1.00
	Z	.3	1.9	.25	.41
	X	3.1*	15.5*	.09	.16
GWC	Y	1.3	1.0	.03	.08
	Z	.4	2.1	.02	.04
	X	5.5*	29.3*	.04	.06
FCC	Y	.3	.6	.05	.04
	Z	1.1	8.4*	.06	.17
	X	6.7*	27.8*	.01	.13
YKC	Y	1.4	4.3*	.33	.28
	Z	2.7	11.0*	.02	.05
	X	.4	2.5	.07	.02
BLC	Y	1.4	1.5	.15	.12
	Z	.4	8.0*	.01	.01
	X	.2	.5	.02	.05
CBB	Y	4.0*	4.7*	.60	.48
	Z	.9	16.5*	.10	.27
	X	.8	.9	.16	.18
RES	Y	3.8*	6.4*	.47	.93
	Z	13.2*	3.7*	.05	.65

* Significant difference

TABLE 2

Standard Deviations for SV Analyses

Component	Nighttime	Quiet Day	All Day
X	8.2	8.0	9.4
Y	5.4	4.9	4.8
Z	7.8	7.7	9.4

Possible Applications of the Undisturbed Reference Level

The reference levels determined from the quiet nighttime levels have applications in the analysis and separation of internal and external fields including determination of their sources. These reference levels can also be used to check the data from an observatory during the final processing stage. They might be used for better determination of the perturbations for improved forecasts of magnetic activity for special events or campaigns and timely synoptic presentations of activity. Further, the undisturbed reference levels are also physically more meaningful than those that might be determined from the "quiet day" annual means (Fig. 4), which averages the Sq and other variations with the nighttime disturbances. Because these reference levels have a number of applications, it is recommended that they be used for such special studies. A program for this is PMULFL (see Appendix D), which plots the undisturbed reference levels and the variations.

This program first initializes various parameters for plotting and also the coefficients for filtering. It then reads the required day for plotting and searches the tape for this day. The reference levels for the day are obtained from the QBLSV subroutine and these values are then subtracted before plotting the data. The coefficients for the reference levels were previously determined from the FBLSV program. These baselines are also indicated on the plot. Finally, the data can be filtered and again plotted. Such plots are more meaningful with the additional baseline information, which can be used to qualitatively determine the perturbations. These can then be used for investigations of the nature and direction of some external current systems or for correcting local magnetic surveys for temporal variations. From a number of nearby stations, stack plots can be similarly prepared with reference levels before quantitatively determining the perturbations and modeling of external sources.

References

Campbell, W.H., Secular, annual and semiannual changes in the baseline level of the Earth's magnetic field at North American locations, J. Geophys. Res., 85, 6557, 1980.

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Mayaud, P.N., Derivation, Meaning and Use of Geomagnetic Indices, Geophys. Monogr. Ser., Vol. 22, AGU, Washington, D.C., 1980.

Walker, J.K., Extremely quiet nighttime currents and magnetic baselines at Canadian observatories for the separation of external and internal fields, J. Geophys. Res., 87, No. A9, 7525, 1982.

Acknowledgement

It is a pleasure to thank D. Champagne for assistance with testing and refining of the programs, G.V. Haines for several fruitful discussions and R. Coles for perusing the manuscript.

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      PROGRAM POBLSV(INPUT=65,OUTPUT=300,TAPE1,TAPE5=INPUT,TAPE6=OUTPUT,
     1TAPE2,TAPE3,TAPE4,TAPE8,TAPE9,TAPE7=300)
C
C   JK WALKER EPB/EMR OTTAWA PH (613) 995-5545  MOD 1/2/84
C  THIS PROGRAM DETERMINES THE SMOOTHED NIGHT TIME LEVEL ON QUIET DAYS
C  AND PLOTS THE MAGNETOGRAM TOGETHER WITH THESE LEVELS. FROM SEVERAL
C LEVELS DETERMINED OVER AN EXTENDED TIME INTERVAL THE SECULAR VARIATION
C IS ALSO CALCULATED AND PLOTTED.
C  SUBROUTINES REQUIRED: CALCOMPS PLOTS, FILTL, REVERS, AAS003, SELSTN,
C  PLOTLIB, PLOTCV, ACS015, XLINPL
      DIMENSION TOT(4),SD(4),VMIN(4),VMAX(4),DAT(1440),S(1440),AVE(4),
     1FI(4),T(99),CAVE(99,4),XP(4),TP(4),X(99),Y(99),Z(99),WT(99),BUF(9)
      COMMON IDAT(1440,4),MNVAL(4),SMARK(1440),HMK(24),SCNP(8),SCSYM(8),
     1LHDZ(3)
C   FOLLOWING COEF. ARE FOR DATA AT I MIN SAMPLES
C  FOLLOWING COEF. FOR LOW PASS(30 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.641066,0.677730,-1.812110,0.852595/,G/10779.452/
C  FOLLOWING COEF. FOR LOW PASS(60 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.813870,0.823862,-1.912535,0.923071/,G/151991.036/
C  FOLLOWING COEF. FOR LOW PASS(120 MIN CUTOFF) BUTTERWORTH FILTER
      DATA FI/-1.905139,0.907753,-1.958041,0.960728/,G/2277141.246/
C  FOLLOWING COEF. FOR LOW PASS(180 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.936345,0.937525,-1.972437,0.973639/,G/11272475.060/
C  FOLLOWING COEF. FOR LOW PASS(240 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.952104,0.952773,-1.979484,0.98013/,G/35234907.725/
C  FOLLOWING COEF. FOR LOW PASS(360 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.967963,.968263,-1.986428,.986730/G/176361481.852/
C  FOLLOWING COEF. FOR LOW PASS(480 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.975933,.976102,-1.989861,.990031/G/554292845.565/
C NO IS THE NUMBER OF GOOD DAYS OF A STATION FOR A GIVEN NUMBER OF YEARS
C IT IS THE TAPE NUMBER
C TDPL COUNTS THE NUMBER OF YEARS THAT STATION HAS BEEN RUN
     1,PLX,PLN,PLA,PLC,PLD,XSH,XDIV,YSH,YDIV/
     10.0,0.8,0.9,-10.,2.0,5.6,20.,2.8,12.7/
      ISCALE=IPLOT=NOIND=1.0
      INSS=4H CAN
      NODEP=3
      CSC=8H0500CAN
      INDSW=JDAY=0
C     FOR 10 MM/H USE HRLN=0.3937005; FOR 20 MM/H USE HRLN=0.7874015
      HRLN=0.3937005
      BUF(1)=0
      CALL PLOTS(BUF,1)
      CALL PLOT(0.5,0.5,-3)
      CALL FACTOR (.635)
      LHDZ(1)=1HZ
      LHDZ(2)=1HY
      LHDZ(3)=1HX
C STANDARD DEVIATION REJECTION LEVEL AND SECOND WEIGHT
      IT=0
C   INITIALIZE FILTER COEF.
       DO 51 I=1,1440
   51 DAT(I)=0
      CALL FILTL(DAT,1,FI)
8     NO=0
      WT2=5.
      TDPL=0
      XDEC=HRLN/60.
      INUM=0
    5 SMARK(1)=1.4
      KDA=0
      JDAY=0
      YEAR=365.
C INCREMENT THE NUMBER OF YEAR AND THE TAPE NUMBER
      TDPL=TDPL+1
      IT=IT+1
      DO 10 K=2,1440
   10 SMARK(K)=SMARK(K-1)+XDEC
      HMK(1)=SMARK(1440)
      DO 30 K=1,8
       DO 20 I=1,3
       J=(K-1)*3+I
       IF(J.NE.1) HMK(J)=HMK(J-1)-HRLN
   20  CONTINUE
      M=IABS(K-9)
      SCSYM(M)=M*3.
```

```
C  ON INPUT WE HAVE THE QUIET DAYS. AFTER THESE DAYS WE PUT A BLANK      991
C  CARD IF IT IS THE END OF THAT STATION OR THE END OF THE INPUT         992
C  CARDS. WE PUT A -1 AFTER THE QUIET DAYS IF THE FOLLOWING CARDS        993
C  ARE FOR THE SAME STATION BUT FOR ANOTHER YEAR.                        994
   30 SCNP(M)=HMK(J-2)-0.1                                              1000
C                                                                       1010
C   READ IN QUIET DAYS: STATION, DAY OF YEAR, PLOT SWITCH, CARD NO      1020
C   SET IDAY TO ZERO AFTER LAST DAY AND NEG FOR NEW YEAR/TAPE           1030
    2 READ(5,100,END=999)CODE,IDAY,IPQBL,ICRD                           1040
      IF(IDAY)5,99,4                                                    1050
C IF THE DAY READ IS NEGATIVE THEN THE STATION OF THAT YEAR IS          1060
C FINISHED AND THE PROGRAM WILL START ANOTHER YEAR                      1070
C IF THE DAY IS 0 THEN THAT STATION IS FINISHED PROCESSING AND          1080
C WE BRANCH TO THE PLOTTING SECTION                                     1090
C IF THE DAY IS POSITIVE THEN WE PROCESS THAT DATA                      1100
C WHEN WE FIND AN END OF FILE SITUATION WE CLOSE THE PLOTTING SYSTEM    1110
  100 FORMAT(A4,I4,I4,50X,I6)                                           1120
    4 ISD=0                                                             1130
C INCREMENT NUMBER OF DAYS AND CHECK THE SEQUENCE OF THE DAY            1140
      INUM=INUM+1                                                       1150
      IF(IDAY.GT.KDA) GO TO 9                                           1160
      PRINT 284                                                         1170
 284  FORMAT(1H ,19HDAY OUT OF SEQUENCE)                                1180
      GO TO 2                                                           1190
 9    KDA=IDAY                                                          1200
      TL=0                                                              1210
      IDAY1=IDAY-1                                                      1220
C                                                                       1230
C   SEARCH TAPE FOR QUIET DAY                                           1240
C WE WILL SEARCH THE TAPE FOR ONE DAY BEFORE THE QUIET DAY              1250
C SO THAT THE NEXT READ WILL ACCESS THE APPROPRIATE QUIET               1260
C DAY.                                                                  1270
      IF(JDAY-IDAY1)40,70,2                                             1280
   40 READ(IT,END=99)IDENTT,JYR,JDAY,IHOR                               1290
      IF(JDAY-IDAY1)40,60,2                                             1300
C WHEN THE END OF THE TAPE IS REACHED,REGRESSION ANAYSIS                1310
C AND PLOTTING IS DONE                                                  1320
   60 IF(IHOR-23)40,70,2                                                1330
C   READ QUIET DAY FROM TAPE                                            1340
   70 DO 80 I=1,24                                                      1350
      K=(I-1)*60+1                                                      1360
      L=K+59                                                            1370
C WE NOW READ THE QUIET DAY                                             1380
      READ(IT,END=99)IDENTT,JYR,JDAY,IHOR,(IDAT(J,2),IDAT(J,3),IDAT(J,1)1390
     1,IDAT(J,4),J=K,L)                                                 1400
   80 CONTINUE                                                          1410
  205 FORMAT(1H ,I6,I5,4I5,3I6,I8,3F6.0)                                1420
C INCREMENT NUMBER OF GOOD DAYS                                         1430
      NO=NO+1                                                           1440
      ISCALE =1                                                         1450
      WT(NO)=1.0                                                        1460
      IF(NO.LE.1) THEN                                                  1470
      IF(NO.EQ.1)JYRB=JYR                                               1480
      IF(MOD(JYR,4).EQ.0)YEAR=366.                                      1490
C   GET STATION NAME AND COORDINATES                                    1500
      CALL SELSTN(IDENTT,NAME,LATGR,LONGGR,LATGM,LONGGM)                1510
      DECODE(6,400,LATGR)FLAT                                           1520
      DECODE(6,400,LONGGR)FLONG                                         1530
      LATTH=FLAT*1000.                                                  1540
      SDRJCT=15 .                                                       1541
      IF(FLAT.LT.45.) SDRJCT=8.                                         1542
      LONGTH=(360.-FLONG)*1000.                                         1550
C     LOCAL MIDNIGHT, EVENING AND MORNING TIME(MIN)                     1560
      TMIDM=FLONG*4.                                                    1570
      TEVNG=TMIDM-180.                                                  1580
      TMORN=TMIDM+180.                                                  1590
      PRINT 205,IDENTT,JYR,JDAY,IHOR,L,I,IDAT(L,2),IDAT(L,3),IDAT(L,1)  1600
     1,IDAT(L,4),TMIDM,TEVNG,TMORN                                      1610
      IF(INUM.LE.1) PRINT 220                                           1620
  220 FORMAT(80H1 STNID        NAME  YR    DAY  HOUR OBS MISD     AVE    SD 1630
     1 MIN      MAX  WT      CD)                                        1640
      END IF                                                            1650
   89 JYRTH=(JYR+JDAY/YEAR+.0007)*1000.+.5                              1660
      T(NO)=JDAY+(JYR-JYRB)*YEAR                                        1670
C  CHECK FOR SUNLIT OR TWILIGHT CONDITIONS AND REJECT OR REDUCE INTERVAL1680
      IF(JDAY.GE.100.AND.JDAY.LE.265) THEN                              1690
      IF(FLAT.GT.74)ISD=1                                               1700
      IF(FLAT.GT.55)TL=60.                                              1710
      END IF                                                            1720
```

```
   74 IF (JDAY.GE.140.AND.JDAY.LE.205) THEN
      IF(FLAT.GT.55.)ISD=1
      IF(FLAT.GT.45.)TL=60.
      END IF
   76 TE=TEVNG+TL
      TM=TMORN-TL
      IF(NO.GT.97) GO TO 98
      IF(IPOBL.GT.0) GO TO 88
C
C     CHECK FOR MISSING DATA
      DO 72 J=1,L
   72 IDAT(J,4)=DAT(J)
      DO 86 I=1,3
      MISD=0
       DO 82 J=1,L
       DAT(J)=IDAT(J,I)
       S(J)=DAT(J)
C   FOR IMS DATA USE 9999 IN FOLLOWING STATEMENT
       IF(DAT(J).GE.90000.) THEN
       MISD=MISD+1
       S(J)=0.0
       END IF
   82  CONTINUE
      IF(MISD.GT.1000) ISD=1
      IF(MISD.LE.1400) THEN
C
C   DETERMINE DAILY AVERAGE & STANDARD DEVIATION
      CALL AAS003(DAT,S,TOT(I),AVE(I),SD(I),VMIN(I),VMAX(I),L,1)
      DO 83 J=1,L
      IF(DAT(J).GT.90000.)DAT(J)=AVE(I)
   83 DAT(J)=DAT(J)-AVE(I)
      PRINT 210,IDENTT,CODE,JYR,JDAY,IHOR,L,MISD,AVE(I),SD(I),VMIN(I),
     1VMAX(I),TL,ICRD
C
C  FILTER DATA TO REMOVE TRANSIENTS ETC
      CALL FILTL(DAT,L,FI)
      CALL REVERS(DAT,S,L,G)
      CALL FILTL(DAT,L,FI)
      CALL REVERS(DAT,S,L,G)
      DO 84 J=1,L
      DAT(J)=DAT(J)+AVE(I)
C   DETERMINE NIGHT TIME AVERAGE & SD
   84 IF(J.LT.TE.OR.J.GT.TM)S(J)=0.0
      CALL AAS003(DAT,S,TOT(I),AVE(I),SD(I),VMIN(I),VMAX(I),L,1)
      IF(SD(I).GT.SDRJCT)ISD=1
      IF(SD(I).GT.WT2)WT(NO)=0.5
      MNVAL(I)=AVE(I)+.5
      CAVE(NO,I)=AVE(I)
      IF(SD(I).GT.SDRJCT)ISCALE=2
      NHOR=(TM-TE)/60.+.5
      END IF
      WT(NO)=1./SD(I)
   86 PRINT 210,IDENTT,NAME,JYR,JDAY,NHOR,L,MISD,AVE(I),SD(I),VMIN(I),
     1VMAX(I),WT(NO)
  210 FORMAT(1H ,I6,A11,I5,4I5,F7.0,F5.0,2F7.0,F5.1,I9)
      FF=SQRT(CAVE(NO,1)*CAVE(NO,1)+CAVE(NO,2)*CAVE(NO,2)+CAVE(NO,3)**2)
      PRINT 210,IDENTT,NAME,JYR,JDAY,IHOR,L,MISD,FF,TE,TM
      IF(ISD.EQ.1)PRINT 230,SDRJCT
      PRINT 232
C  PLOT MAGNETOGRAM AND QUIET NIGHT TIME LEVEL
  232 FORMAT(1H )
  230 FORMAT(58H DAY REJECTED; MISS. DATA, SUNLIT OR STANDARD DEVEATION
     1GT,F4.0)
C   PUNCH UNDISTURBED LEVELS FOR SV STUDIES
      IFF=FF+.5
      IF(ISD.NE.1) THEN
      IF(IDENTT.EQ.15265.OR.IDENTT.EQ.007298.OR.IDENTT.EQ.14241) THEN
      WRITE(7,300)CSC,NAME,LATTH,LONGTH,JYRTH,MNVAL(3),MNVAL(2),MNVAL(1)
     1,IFF
      ELSE
   94 WRITE(7,300)CSC,NAME,LATTH,LONGTH,JYRTH,MNVAL(2),MNVAL(3),MNVAL(1)
     1,IFF
      END IF
      END IF
   92 IF(ISD.EQ.1)NO=NO-1
  300 FORMAT(A8,A10,11X,I6,I7,I8,I7,6X,I5,I6,I5)
  400 FORMAT(F6.2)
```

```
      IF(ISD.EQ.1) GO TO 2                                             2490
   88 CALL PLOTLB(NAME,JYR,JDAY,ISCALE,INSS)                           2500
      CALL PLOTCV(ISCALE,INDSW)                                        2510
      GO TO 2                                                          2520
   98 PRINT 250,ND                                                     2530
  250 FORMAT(1H ,I3,17HDAYS GT DIMENSION)                              2540
      ND=ND-1                                                          2542
C                                                                      2550
C   LINEAR REGRESSION ANALYSIS OF QUIET LEVELS                         2560
   99 XMIN=YMIN=ZMIN=70000.                                            2570
      XMAX=YMAX=ZMAX=-50000.                                           2580
      DO 90 I=1,ND                                                     2590
      Z(I)=CAVE(I,1)                                                   2600
      X(I)=CAVE(I,3)                                                   2610
      Y(I)=CAVE(I,2)                                                   2620
      XMAX=AMAX1(XMAX,X(I))                                            2630
      XMIN=AMIN1(XMIN,X(I))                                            2640
      ZMIN=AMIN1(ZMIN,Z(I))                                            2650
      YMAX=AMAX1(YMAX,Y(I))                                            2660
      ZMAX=AMAX1(ZMAX,Z(I))                                            2670
      YMIN=AMIN1(YMIN,Y(I))                                            2680
   90 WRITE(8)T(I),CAVE(I,1),CAVE(I,3),CAVE(I,2),WT(I)                 2690
      CALL ACS015(ND,NOIND,NODEP,IPLOT,8,6)                            2700
      REWIND 9                                                         2710
C                                                                      2720
C     PLOT QUIET LEVELS AND LINEAR REGRESSION FIT                      2730
      READ(9)B0,B1                                                     2740
      TDPL=TDPL*YEAR                                                   2750
      TP(1)=1                                                          2760
      TP(2)=TDPL                                                       2770
      ZB1=B0+B1*TP(1)                                                  2780
      ZB2=B0+B1*TP(2)                                                  2790
      XP(1)=AMIN1(ZMIN,ZB1,ZB2)                                        2800
      XP(2)=AMAX1(ZMAX,ZB1,ZB2)                                        2810
      XSH=TDPL/100.+.05                                                2820
      CALL XLINPL(2,TP,XP,PLX,XSH,XDIV,YSH,YDIV,4,4HTIME,1,1HZ)        2830
      XP(1)=ZB1                                                        2840
      XP(2)=ZB2                                                        2850
      PRINT 240, ZMIN,ZMAX,XP(1),XP(2),B0,B1,(Z(I),I=1,12)             2860
  240 FORMAT(1H ,5F7.0,F10.3,12F7.0)                                   2870
      CALL XLINPL(2,TP,XP,PLO,XSH,XDIV,YSH,YDIV,0,0,0,0)               2880
      CALL XLINPL(ND,T,Z,PLC,XSH,XDIV,YSH,YDIV,0,0,0,0)                2890
      READ(9)B0,B1                                                     2900
      XB1=B0+B1*TP(1)                                                  2910
      XB2=B0+B1*TP(2)                                                  2920
      XP(1)=AMIN1(XMIN,XB1,XB2)                                        2930
      XP(2)=AMAX1(XMAX,XB1,XB2)                                        2940
      CALL XLINPL(2,TP,XP,0.1,XSH,XDIV,YSH,YDIV,0,0,1,1HX)             2950
      XP(2)=XB2                                                        2960
      XP(1)=XB1                                                        2970
      PRINT 240,XMIN,XMAX,XP(1),XP(2),B0,B1,(X(I),I=1,12)              2980
      CALL XLINPL(2,TP,XP,PLO,XSH,XDIV,YSH,YDIV,0,0,1,1HX)             2990
      CALL XLINPL(ND,T,X,PLC,XSH,XDIV,YSH,YDIV,0,0,0,0)                3000
      READ(9)B0,B1                                                     3010
      YB1=B0+B1*TP(1)                                                  3020
      YB2=B0+B1*TP(2)                                                  3030
      XP(1)=AMIN1(YMIN,YB1,YB2)                                        3040
      XP(2)=AMAX1(YMAX,YB1,YB2)                                        3050
      CALL XLINPL(2,TP,XP,0.1,XSH,XDIV,YSH,YDIV,0,0,1,1HY)             3060
      XP(2)=YB2                                                        3070
      XP(1)=YB1                                                        3080
      PRINT 240,YMIN,YMAX,XP(1),XP(2),B0,B1,(Y(I),I=1,12)              3090
      CALL XLINPL(2,TP,XP,PLO,XSH,XDIV,YSH,YDIV,0,0,1,1HY)             3100
      CALL XLINPL(ND,T,Y,PLC,XSH,XDIV,YSH,YDIV,0,0,0,0)                3110
      XP(1)=0.0                                                        3112
      XP(2)=1.0                                                        3114
      CALL XLINPL(2,TP,XP,0.1,XSH,XDIV,YSH*.5,YDIV,0,0,2,2HWT)         3116
      CALL XLINPL(ND,T,WT,PLC,XSH,XDIV,YSH*.5,YDIV,0,0,0,0)            3120
      CALL PLOT(XSH+.5,-YSH*3.,-3)                                     3130
      PRINT 281,INUM                                                   3140
      PRINT 282,ND                                                     3150
      IF(ND.LT.97)GO TO 8                                              3160
 281  FORMAT(1H ,22HTOTAL NUMBER OF DAYS =,I3)                         3170
 282  FORMAT(1H ,27HTOTAL NUMBER OF GOOD DAYS =,I3)                    3180
  999 CALL PLOT(0.0,0.0,999)                                           3190
      END                                                              3200
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      SUBROUTINE FILTL (X,IS,FI)                                        5450
C                                                                       5460
C     FILTER VERSION 2                                                  5470
C     SUBROUTINE WHICH DOES THE RECURSIVE FILTERING, FOR LOW PASS FILTER5480
C     (USE SR FILTER FOR BAND-PASS FILTERING)                           5490
C     IS DATA POINTS ARE IN VECTOR X                                    5500
C     FILTER COEFFICIENTS ARE IN FI                                     5510
C                                                                       5520
      DIMENSION X(IS),FI(4),C(3)
      DATA FHOLD,FCHK/0.,0.000001/                                      5540
      MOD3(INDEX)=INDEX-((INDEX-1)/3)*3                                 5550
      IF (ABS(FHOLD-FI(1)).GT.FCHK)WRITE(6,3) IS,FI                     5560
      FHOLD = FI(1)                                                     5570
C                                                                       5580
C     START UP FILTER                                                   5590
      XIM2=X(1)                                                         5600
      XIM1=X(2)                                                         5610
      XI=X(3)                                                           5620
      C(1)=XIM2                                                         5630
      C(2)=XIM1+2.0*XIM2-FI(1)*C(1)                                     5640
      C(3)=XI+2.0*XIM1+XIM2-FI(1)*C(2)-FI(2)*C(1)                       5650
      X(1)=C(1)                                                         5660
      X(2)=C(2)+2.0*C(1)-FI(3)*X(1)                                     5670
      X(3)=C(3)+2.0*C(2)+C(1)-FI(3)*X(2)-FI(4)*X(1)                     5680
C                                                                       5690
C     FILTER REMAINING POINTS                                           5700
      DO 2 I=4,IS                                                       5710
      XIM2=XIM1                                                         5720
      XIM1=XI                                                           5730
      XI=X(I)                                                           5740
      IL=MOD3(I)                                                        5750
      IM1L=MOD3(I-1)                                                    5760
      IM2L=MOD3(I-2)                                                    5770
      C(IL)=XI+2.0*XIM1+XIM2-FI(1)*C(IM1L)-FI(2)*C(IM2L)                5780
      X(I)=C(IL)+2.0*C(IM1L)+C(IM2L)-FI(3)*X(I-1)-FI(4)*X(I-2)          5790
      IWRT=0                                                            5800
      DO 1 K=1,3                                                        5810
      IF (C(K).EQ.0.0) IWRT=1                                           5820
1     CONTINUE                                                          5830
C     IF(IWRT.EQ.1)WRITE(6,201)I,C                                      5840
201   FORMAT(3H I=,I6,3(1X,E12.6))                                      5850
2     CONTINUE                                                          5860
      RETURN                                                            5870
C                                                                       5880
 3    FORMAT (       "OENTRY TO FILTL. VECTOR HAS LENGTH",I6," AND FILTER5890
     1 COEFFICIENTS ARE",4F10.6)                                        5900
      END                                                               5910
      SUBROUTINE REVERS (X,TEMP,III,G)                                  5920
C     SR TO REVERSE TIME SERIES AND DIVIDE BY MID-BAND GAIN OF FILTER   5930
C     SERIES IS IN X AND IS RETURNED TO X                               5940
C     TEMP IS TEMPORARY STORAGE VECTOR, OF HALF THE SIZE OF X           5950
C     III  NO. OF POINTS IN X , ASSUMED AN EVEN NUMBER                  5960
C     G    MID-BAND GAIN OF FILTER, FROM SR GAIN                        5970
C                                                                       5980
      DIMENSION X(III),TEMP(III/2)
      N=III+1                                                           6000
      II=III/2                                                          6010
      IV=II+1                                                           6020
C     PUT X(1 TO III/2) INTO TEMP(1 TO III/2)                           6030
      DO 1 I=1,II                                                       6040
      TEMP(I)=X(I)/G                                                    6050
1     CONTINUE                                                          6060
C     PUT X(III/2+1 TO III) INTO X(III/2 TO 1)                          6070
      DO 2 I=IV,III                                                     6080
      J=N-I                                                             6090
      X(J)=X(I)/G                                                       6100
2     CONTINUE                                                          6110
C     PUT TEMP(1 TO III/2) INTO X(III TO III/2+1)                       6120
      DO 3 I=1,II                                                       6130
      J=N-I                                                             6140
      X(J)=TEMP(I)                                                      6150
3     CONTINUE                                                          6160
      RETURN                                                            6170
      END                                                               6180
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      SUBROUTINE XYLGPL(N,X,Y,AX,XSH,XDIV,YSH,YDIV,NSX,XNAME,NSY,YNAME) 1950
C     PLOTS ON CALCOMP EITHER LOG, SEMILOG OR LINERLY                   1960
C     FOR AX GT 0.9 NO AXIS IS PLOTTED                                  1970
C     FOR AX EQ ONE A RECTANGLE IS PLOTTED                              1980
C     IF AX GT 2.5 A CHACTER IS PLOTTED WITH THE LINE                   1990
C     IF AX LT 2.5 A CHACTER IS ONLY PLOTTED                            2000
C     IF AX EQ 0.0 ONLY THE AXIS IS PLOTTED                             2010
C     IF AX EQ0.5 AN X TYPE AXIS IS PLOTTED                             2020
C     IF AX GT 20. A DASHED LINE IS PLOTTED                             2030
C     IF AX EQ 0.1 THEN NEW AXIS AND PLOT ABOVE OLD PLOT                2040
C     IF AX GT 0.5 AND LT 0.9 THEN NEW FRAME AND GRAPH PLOTTED
C     NEWXDIV AND YDIV ARE CALC FOR LOG PLOTS                           2060
      DIMENSION X(N+2),Y(N+2)
      DATAXL,YL,XLL,NT,YMIN,YMAX,XMIN,XMAX/0.,0.,0.,0,99.,-99.,99.,-99./2080
      IF(ABS(AX).GT.0.9) GO TO 1                                        2090
C  DETERMINES SCALE AND INCREMENTAL LOG X+Y VALUES AND STORES THEM      2100
      CALL SCALG(X,XSH,N,1)                                             2110
      CALL SCALG(Y,YSH,N,1)                                             2120
      XMINL=X(N+1)                                                      2130
      YMINL=Y(N+1)                                                      2140
      XDELTA=X(N+2)                                                     2150
      YDELTA=Y(N+2)                                                     2160
 10   IF(AX.NE.0.9.AND.AX.NE.0.0.AND.NT.NE.0) GO TO 15
   12 XL=XLL                                                            2180
      CALL PLOT(XL,YL,-3)                                               2190
      CALL LGAXS(0.0,0.0,XNAME,-NSX,XSH,0.0,X(N+1),X(N+2))              2200
      CALL LGAXS(0.0,0.0,YNAME,NSY,YSH,90.0,Y(N+1),Y(N+2))              2210
      CALL LGAXS(0.0,YSH,1H ,1,XSH,0.0,X(N+1),X(N+2))                   2220
      CALL LGAXS(XSH,0.0,1H ,-1,YSH,90.0,Y(N+1),Y(N+2))                 2230
      NT=1                                                              2240
      XL=YL=XLL=0.0                                                     2250
      XLL=AMAX1(XLL,XSH+4.0)                                            2260
      IF(ABS(AX).LT.0.6) GO TO 99                                       2270
    1 N1=N+1                                                            2280
      N2=N+2                                                            2290
      X(N1)=XMINL                                                       2300
      Y(N1)=YMINL                                                       2310
      X(N2)=XDELTA                                                      2320
      Y(N2)=YDELTA                                                      2330
   15 LINTYPE=AX                                                        2340
      INTEG=ABS(AX)                                                     2350
      CALL LGLIN(X,Y,N,1,LINTYPE,INTEG,0)                               2360
      GO TO 99                                                          2370
      ENTRY YLOGPL                                                      2380
      IF(ABS(AX).GT.0.9) GO TO 6                                        2390
      CALL SCALG(X,XSH,N,1)                                             2400
      CALL SCALE1(Y,YSH,N,1,YDIV)                                       2410
      XMINL=X(N+1)                                                      2420
      YMINL=Y(N+1)                                                      2430
      XDELTA=X(N+2)                                                     2440
      YDELTA=Y(N+2)                                                     2450
      XL=XLL                                                            2460
      CALL PLOT(XL,YL,-3)                                               2470
      XL=YL=XLL=0.0                                                     2480
      XLL=AMAX1(XLL,XSH+4.0)                                            2490
      CALL LGAXS(0.0,0.0,XNAME,-NSX,XSH,0.0,X(N+1),X(N+2))              2500
      CALL AXIS1(0.0,0.0,YNAME,NSY,YSH,90.0,Y(N+1),Y(N+2),YDIV)         2510
      CALL LGAXS(0.0,YSH,1H ,1,XSH,0.0,X(N+1),X(N+2))                   2520
      CALL AXIS1(XSH,0.0,1H ,-1,YSH,90.0,1.0E+53,Y(N+2),YDIV)           2530
      IF(ABS(AX).LT.0.6) GO TO 99                                       2540
    6 N1=N+1                                                            2550
      N2=N+2                                                            2560
      X(N1)=XMINL                                                       2570
      X(N2)=XDELTA                                                      2580
      Y(N1)=YMINL                                                       2590
      Y(N2)=YDELTA                                                      2600
      LINTYPE=AX                                                        2610
      INTEG=ABS(AX)                                                     2620
      CALL LGLIN(X,Y,N,1,LINTYPE,INTEG,-1)                              2630
      GO TO 99                                                          2640
      ENTRY XLINPL                                                      2650
      IF(ABS(AX).GT.0.9) GO TO 7                                        2660
      CALL SCALE1(Y,YSH,N,1,YDIV)                                       2670
      CALL SCALE1(X,XSH,N,1,XDIV)                                       2680
      IF(ABS(AX).LE.1.0.OR.NT.EQ.0)GO TO 5                              2690
    7 N1=N+1                                                            2700
```

```
      N2=N+2
      X(N1)=XMINL
      X(N2)=XDELTA
      Y(N1)=YMINL
      Y(N2)=YDELTA
      GO TO 4
    5 NT=1
    8 XMINL=X(N+1)
      XDELTA=X(N+2)
      YMINL=Y(N+1)
      YDELTA=Y(N+2)
      XL=XLL
      XLL=0.0
      IF(AX.NE.0.1.AND.AX.NE.0.9) GO TO 3
   30 CALL PLOT(0.0,YSHO,-3)
      YL=YL-YSHO
      X(N+1)=1.0E+53
      GO TO 40
    3 CALL PLOT(XL,YL,-3)
      YL=0.0
   40 XL=0.0
      XLL=AMAX1(XLL,XSH+4.0)
      IF(AX.EQ.0.5) GO TO 9
      CALL AXIS1(0.0,0.0,XNAME,-NSX,XSH,0.0,X(N+1),X(N+2),XDIV)
      CALL AXIS1(0.0,0.0,YNAME,NSY,YSH,90.0,Y(N+1),Y(N+2),YDIV)
      CALL AXIS1(0.0,YSH,1H ,1,XSH,0.0,1.0E+53,0.0,XDIV)
      CALL AXIS1(XSH,C.0,1H ,-1,YSH,90.0,1.0E+53,0.0,YDIV)
      IF(AX.EQ.0.9)X(N+1)=XMINL
      GO TO 4
    9 CALL AXIS1(0.0,YSH/2.0,XNAME,-NSX,XSH,0.0,X(N+1),X(N+2),XDIV)
      CALL AXIS1(XSH/2.0,0.0,YNAME,NSY,YSH,90.0,Y(N+1),Y(N+2),YDIV)
    4 AL=ABS(AX)
      L=ABS(AX)
      IF(AL.LT.0.6) GO TO 99
      IF(AX.GT.-2.5.AND.AX.LT.2.5) CALL LINE(X,Y,N,1,0,0)
      IF(AX.LT.-2.5)CALL LINE(X,Y,N,1,-1,L)
      IF(AX.GT.2.5.AND.AX.LT.20.)CALL LINE(X,Y,N,1,1,L)
      IF(AX.GT.20.)CALL DASHL(X,Y,N,1)
   99 XMIN=YMIN=99.
      XMAX=YMAX=-99.
      YSHO=YSH
      END
      SUBROUTINE PLOTLB (NAME,IYR,IDAY,ISCALE,ISS)
      COMMON IDAT(1440,4),MNVAL(4),SMARK(1440),HMK(24),SCNP(8),SCSYM(8),
     1LHDZ(3)
C     $     ARRAYS
C
C     .....PLOTTING THE SCALE MARK
C
      YDISP=6.5
      XDISP=0.0
      CALL PLOT (XDISP,YDISP,3)
      XMK=XDISP-0.3
      XNUM=0.0
      DO 10 I=1,6
C     CALL SYMBOL (XDISP,YDISP,0.10,17,90.0,-1)
      CALL TIKS(XDISP,YDISP,0.1,-90.)
      CALL NUMBER (XMK,YDISP,0.1,XNUM,0.0,-1)
      IF (I.EQ.6) GO TO 20
      CALL PLOT (XDISP,YDISP,3)
      XNUM=XNUM+10.0
      YDISP=YDISP+0.3937007874
      CALL PLOT (XDISP,YDISP,2)
   10 CONTINUE
   20 XDISP=XDISP+0.1
      CALL SYMBOL (XDISP,1.5,0.2,NAME,90.0,10)
      CALL SYMBOL (999.,999.,0.25,ISS,90.0,3)
      CALL CLDATE (IDAY,IYR,MNTH,IDATE)
      XDISP=XDISP+0.3
      DTF=FLOAT(IDATE)
      CALL SYMBOL (XDISP,1.5,0.2,MNTH,90.0,5)
      CALL NUMBER (999.,999.,0.2,DTF,90.0,-1)
      YEAR=FLOAT(IYR)
C     CALL SYMBOL (999.,999.,0.2,73,90.0,-1)
      CALL SYMBOL(999.,999.,0.2,46,90.,0)
      CALL NUMBER (999.,999.,0.2,YEAR,90.0,-1)
      CALL SYMBOL (999.,999.,0.2,5H U.T.,90.0,5)
      SNUMB=FLOAT(ISCALE)*5.0
      CALL SYMBOL(999.,999.,0.2,10HSCALE VAL.,90.,10)
      CALL NUMBER (999.,999.,0.2,SNUMB,90.0,-1)
C     CALL SYMBOL (999.,999.,0.2,89,90.0,-1)
      CALL TES(999.,999.,0.2,90.)
      CALL WHERE(XX1,YY1,FCT)
      CALL SYMBOL(XX1,YY1,0.2,3H/MM,90.0,3)
C     CALL SYMBOL (999.,999.,0.2,3H/MM,90.0,3)
      RETURN
      END
```

```
      SUBROUTINE PLOTCV (ISCALE,INDSW)                                  1200
      DIMENSION FDAT(1440), YSHFT(3)                                    1230
      COMMON IDAT(144C,4),MNVAL(4),SMARK(1440),HMK(24),SCNP(8),SCSYM(8),1240
     1LHDZ(3)                                                           1250
C                                                                       1260
      LBL=2HBL                                                          1270
      I=3                                                               1280
      YSHFT(I)=1.5                                                      1290
C                                                                       1300
C     .....LOOP STARTS HERE                                             1310
C                                                                       1320
10    CONTINUE                                                          1330
      BVAL=FLOAT(MNVAL(I))-127.0*1.66                                   1340
      IF (I.EQ.2) BVAL=BVAL+50                                          1350
C   SCALES DATA                                                         1360
      DO 40 K=1,1440                                                    1370
      IF (IDAT(K,I).GT.90000.OR.IDAT(K,I).EQ.9999) GO TO 20             1380
      GO TO 30                                                          1390
20    FDAT(K)=99999.0                                                   1400
      GO TO 40                                                          1410
30    DISTUR=FLOAT(IDAT(K,I))-BVAL                                      1420
      FDAT(K)=YSHFT(I)+DISTUR/(127.0*ISCALE)                            1430
40    CONTINUE                                                          1440
      YDSP=YSHFT(I)+1.66                                                1450
      QBL=YSHFT(I)+(MNVAL(I)-BVAL)/(127.0*ISCALE)                       1460
      CALL SYMBOL (0.7,QBL,0.2,LHDZ(I),0.0,1)                           1470
C     CALL SYMBOL (999.,999.,0.4,19,0.0,-1)                             1480
      CALL SYMBOL(999.,999.,0.2,2HUL,0.0,2)                             1490
      CALL SYMBOL (999.,999.,0.3,62,0.0,0)                              1500
      FMNV=MNVAL(I)                                                     1510
C  DETERMINE QUIET BASELINES AND PLOT THESE LEVELS                      1520
      CALL NUMBER(0.5,QBL-0.3,0.2,FMNV,0.0,-1)                          1530
C     CALL SYMBOL (0.7,YSHFT(I),0.2,LHDZ(I),0.0,1)                      1540
C     CALL SYMBOL (999.,999.,0.2,LBL,0.0,2)                             1550
      DO 44 K=1,1440,15                                                 1560
      CALL PLOT(SMARK(K),QBL,3)                                         1570
   44 CALL PLOT(SMARK(K+5),QBL,2)                                       1580
      UPS=YSHFT(I)+2.50                                                 1590
      IF(FDAT(1).GT.8.5.OR.FDAT(1).LT.0.1) FDAT(1)=YDSP                 1600
      CALL PLOT ( SMARK(1),FDAT(1),3)                                   1610
      FLLIM=0.1                                                         1620
      IF (I-1) 60,50,60                                                 1630
50    FLLIM=YSHFT(I)-1.25                                               1640
C   PLOTS DATA                                                          1650
60    DO 100 K=2,1440                                                   1660
      TMPVAL=FDAT(K)                                                    1670
      IF (TMPVAL.NE.99999.0) GO TO 70                                   1680
      IF (K.GT.1439) GO TO 100                                          1690
      FDAT1=FDAT(K+1)                                                   1700
      IF(FDAT1.GT.90000.0) GO TO 100                                    1710
      IF (FDAT1.GT.8.5) FDAT1=8.5                                       1720
      IF(FDAT1.LT.0.1) FDAT1=0.1                                        1730
      CALL PLOT (SMARK(K+1),FDAT1,3)                                    1740
      GO TO 100                                                         1750
70    IF (TMPVAL.LT.UPS) GO TO 80                                       1760
      IF (TMPVAL.GT.9.5) TMPVAL=9.5                                     1770
      INDSW=1                                                           1780
      GO TO 90                                                          1790
80    IF (TMPVAL.GT.FLLIM) GO TO 90                                     1800
      IF (TMPVAL.LT. 0.1) TMPVAL= 0.1                                   1810
      INDSW=1                                                           1820
90    CALL PLOT (SMARK(K),TMPVAL,2)                                     1830
100   CONTINUE                                                          1840
C                                                                       1850
      J=I                                                               1860
      I=I+1                                                             1870
      IF(I.EQ.4)I=1                                                     1880
      IF (I.EQ.3) GO TO 120                                             1890
      YSHFT(I)=YSHFT(J)+2.55906                                         1900
      GO TO 10                                                          1910
C PLOTS BASELINES                                                       1920
C     .....PLOT THE TIME MARKS                                          1930
  120 I=I                                                               1940
      CALL PLOT (HMK(1),YSHFT(I),3)                                     1950
      DO 110 K=1,24                                                     1960
      CALL PLOT(HMK(K),YSHFT(I),2)                                      1970
C     CALL SYMBOL (HMK(K),YSHFT(I),0.1,17,0.0,-2)                       1980
C     CALL PLOT (HMK(K),YSHFT(I),3)                                     1990
      CALL TIKS(HMK(K),YSHFT(I),0.1,0.)                                 2000
110   CONTINUE                                                          2010
      CALL PLOT (SMARK(1),YSHFT(I),2)                                   2020
      CALL PLOT (SMARK(1),YSHFT(I),3)                                   2030
      DO 130 IH=1,8                                                     2040
      CALL NUMBER (SCNP(IH),1.2,0.2,SCSYM(IH),0.0,-1)                   2050
130   CONTINUE                                                          2060
      S2M=SMARK(1440)+2.0                                               2070
      CALL PLOT (S2M,0.0,-3)                                            2080
      RETURN                                                            2090
      END                                                               2100
```

```
      SUBROUTINE GMSYMS(XM,YM,HT,ANG)
      DIMENSION XN(20),YN(20),XT(5),YT(5),XG(20),YG(20)
      DATA XN/.2,.4,.5,.55,.55,.55,.6,.7,.9,1.1,1.3,1.5,1.55,1.6,
     11.6,1.[illegible]3,1.55,1.52,1.6,1.6/
      DATA YN/1.5,1.35,1.2,1.,0.,1.,1.15,1.4,1.45,1.5,1.48,1.37,
     1 1.3,1.1,1.0,.7,.5,.3,.0,.0/
      DATA XT/0.,1.,1.,1.,2./
      DATA YT/2.5,2.5,0.0,2.5,2.5/
      DATA XG/0.,.25,.4,.5,.62,.68,.7,.7,.65,.5,.38,.4,.42,.5,.7,.8,
     1.9,1.,1.2,1.5/
      DATA YG/2.,2.9,2.8,2.7,1.5,1.3,1.12,1.0,.6,.15,.0,.3,.5,.72,1.12,
     11.3,1.5,1.65,1.85,1.5/
      ENTRY TES
      X=XM
      Y=YM
      IF(X.NE.999..OR.Y.NE.999.) GO TO 10
      CALL WHERE(X,Y,FCT)
   10 CONTINUE
      NM=20
      HT=ABS(HT)
      FACT=HT/2.5
      CALL PLOTCH(FACT,ANG,NM,XN,YN,X,Y,HT)
      NM=5
      CALL PLOTCH(FACT,ANG,NM,XT,YT,X,Y,HT)
      RETURN
      ENTRY GAMMA
      X=XM
      Y=YM
      IF(X.NE.999..OR.Y.NE.999.) GO TO 5
      CALL WHERE(X,Y,FCT)
    5 CONTINUE
      NM=20
      FACT=HT/2.0
      CALL PLOTCH(FACT,ANG,NM,XG,YG,X,Y,HT)
      RETURN
      END
```

```
      SUBROUTINE AAS003(A,S,TOTAL,AVER,SD,VMIN,VMAX,NO,NV)
      DIMENSION A(1),S(1),TOTAL(1),AVER(1),SD(1),VMIN(1),VMAX(1)
      DO 1 K=1,NV
      TOTAL(K)=0.0
      AVER(K)=0.0
      SD(K)=0.0
      VMIN(K)=1.0E75
1     VMAX(K)=-1.0E75
      SCNT=0.0
      DO 7 J=1,NO
      IJ=J-NO
      IF(S(J)) 2,7,2
2     SCNT=SCNT+1.0
      DO 6 I=1,NV
      IJ=IJ+NO
      TOTAL(I)=TOTAL(I)+A(IJ)
      IF(A(IJ)-VMIN(I)) 3,4,4
3     VMIN(I)=A(IJ)
4     IF(A(IJ)-VMAX(I)) 6,6,5
5     VMAX(I)=A(IJ)
6     SD(I)=SD(I)+A(IJ)*A(IJ)
7     CONTINUE
      DO 8 I=1,NV
      AVER(I)=TOTAL(I)/SCNT
8     SD(I)=SQRT(ABS((SD(I)-TOTAL(I)*TOTAL(I)/SCNT)/(SCNT-1.0)))
      RETURN
      END
```

```
      SUBROUTINE ACSO15(NOBS,NOIND,NODEP,IPLOT,LUN,IOT)                 6190
C     SUBROUTINE ACSO15 (FORMERLY KNOWN AS FLUFF)                       6220
C   PURPOSE  -  COMPUTE LINEAR STEP-WISE REGRESSION                     6230
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * 6240
C     BASED ON A COMPUTER PROGRAM WRITTEN BY DR. K. W. SMILLIE           6250
C  AND MODIFIED BY HOWARD SOMERS AND GEOFF CAMERON OF THE               6260
C  COMPUTER SCIENCE CENTRE, ENERGY MINES AND RESOURCES                  6270
C     ENTERED INTO CDC 6400 EMRLIB, FEBRUARY, 1972                      6280
      DIMENSION S(41,41),SUM(41),SD(41),X(41),CR(40),AV(40),IORD(40),
     *B(40),T(40),NORD(40),SEB(40),Y(20),BORD(40)
C                                                                       6310
C ** CHECK FOR ERROR CONDITIONS                                         6320
C                                                                       6330
      IF(NOIND.GT.40) GO TO 4444
      IF(NODEP.GT.20) GO TO 5555
      NP = NOIND                                                        6360
      ICOF=3                                                            6370
      N = NOBS                                                          6380
      IO = IABS(IOT)                                                    6390
      REWIND LUN                                                        6400
      REWIND 9                                                          6410
C                                                                       6420
C ***   BIG  OUTER  DO  LOOP  TO  PROCESS  EACH  DEP.  VAR.  IN  TURN   6430
C                                                                       6440
      DO 1220    IJKLM = 1, NODEP                                       6450
      WRITE(IO, 910) IJKLM                                              6460
910   FORMAT("1    D E P E N D E N T    V A R I A B L E    N O .",  I8, 6470
     C ////// )                                                         6480
C                                                                       6490
      SWT=0.                                                            6500
      DO 1 I=1,NP                                                       6510
    1 NORD(I)=I                                                         6520
      NP1=NP+1                                                          6530
      DO 2 I=1,NP1                                                      6540
      SUM(I)=0.                                                         6550
      DO 2 J=I,NP1                                                      6560
    2 S(I,J)=0.                                                         6570
C                                                                       6580
      DO 3 IPIV=1,N                                                     6590
 9990 READ(LUN) (X(I), I = 1, NP), (Y(I), I = 1, NODEP), WT             6600
 9991 X(NP1) = Y(IJKLM)                                                 6610
      SWT=SWT+WT                                                        6620
      DO 3 I=1,NP1                                                      6630
      A=X(I)                                                            6640
 9992 SUM(I)=SUM(I)+A*WT                                                6650
      DO 3 J=I,NP1                                                      6660
    3 S(I,J)=S(I,J)+A*X(J)*WT                                           6670
 9994 SST=S(NP1,NP1)-SUM(NP1)**2/SWT                                    6680
      REWIND LUN                                                        6690
C                                                                       6700
      WRITE(IO,4)                                                       6710
    4 FORMAT(47H VARIABLE  AVERAGE VALUE AND STANDARD DEVIATION/)       6720
      DO 5 I=1,NP1                                                      6730
      SUM(I)=SUM(I)/SWT                                                 6740
      DISC1=SQRT((S(I,I)-SWT*SUM(I)**2)/(SWT-1.))                       6750
      IF(DISC1)51,52,52                                                 6760
   51 WRITE(IO,53)DISC1                                                 6770
   53 FORMAT(1H0,"FIRST SQUARE ROOT IS NEGATIVE =",E17.10 )             6780
   52 CONTINUE                                                          6790
      SD(I)=SQRT ((S(I,I)-SWT*SUM(I)**2)/(SWT-1.))                      6800
    5 WRITE(IO,6)I,SUM(I),SD(I)                                         6810
    6 FORMAT(3X,I3,5X,E17.10,1X,E17.10)                                 6820
C                                                                       6830
C     WRITE(IO, 999)                                                    6840
999   FORMAT(//////)                                                    6850
      DO 8 I=1,NP                                                       6860
C     WRITE(IO,7)I                                                      6870
C   7 FORMAT(/42H CORRELATION COEFFICIENT BETWEEN VARIABLES,I3,4H AND ) 6880
      A=SUM(I)                                                          6890
      CR(I)=S(I,I)-SWT*A**2                                             6900
      S(I,I)=1.                                                         6910
      K=I+1                                                             6920
      DO 8 J=K,NP1                                                      6930
      S(I,J)=((S(I,J)-SWT*A*SUM(J))/(SWT-1.))/(SD(I)*SD(J))             6940
C     WRITE(IO,9)S(I,J),J                                               6950
C   9 FORMAT(1X,E17.10,10H----------,I4)                                6960
    8 CONTINUE                                                          6970
C                                                                       6980
      NPM1=NP-1                                                         6990
      DO 10 I=1,NPM1                                                    7000
      K=I+1                                                             7010
      DO 10 J=K,NP                                                      7020
   10 S(J,I)=S(I,J)                                                     7030
      TOT=0.                                                            7040
      IOFT=SWT-1.                                                       7050
      SSR=0.                                                            7060
C                                                                       7070
      DO 24 IPIV=1,NP                                                   7080
      RMAX=0.                                                           7090
      DO 12 I=IPIV,NP                                                   7100
      R=S(I,NP1)**2/S(I,I)                                              7110
      IF(R-RMAX)12,12,11                                                7120
   11 RMAX=R                                                            7130
      NEXT=I                                                            7140
   12 CONTINUE                                                          7150
```

```
      K=NORD(NEXT)                                                      7160
      NORD(NEXT)=NORD(IPIV)                                             7170
      NORD(IPIV)=K                                                      7180
      IORD(IPIV)=K                                                      7190
C                                                                       7200
      SSR=SSR+SST*RMAX                                                  7210
      DO 13 J=1,NP1                                                     7220
      SAVE=S(NEXT,J)                                                    7230
      S(NEXT,J)=S(IPIV,J)                                               7240
   13 S(IPIV,J)=SAVE                                                    7250
      DO 14 I=1,NP                                                      7260
      SAVE=S(I,NEXT)                                                    7270
      S(I,NEXT)=S(I,IPIV)                                               7280
   14 S(I,IPIV)=SAVE                                                    7290
C                                                                       7300
      P=S(IPIV,IPIV)                                                    7310
      S(IPIV,IPIV)=1.                                                   7320
      DO 15 J=1,NP1                                                     7330
   15 S(IPIV,J)=S(IPIV,J)/P                                             7340
      DO 18 K=1,NP                                                      7350
      IF(IPIV-K)16,18,16                                                7360
   16 P=S(K,IPIV)                                                       7370
      S(K,IPIV)=0.                                                      7380
      DO 17 J=1,NP1                                                     7390
   17 S(K,J)=S(K,J)-P*S(IPIV,J)                                         7400
   18 CONTINUE                                                          7410
C                                                                       7420
      SSD=SST-SSR                                                       7430
      IDFD=IDFT-IPIV                                                    7440
      FDFD=IDFD                                                         7450
      SMD=SSD/FDFD                                                      7460
      BO=SUM(NP1)                                                       7470
      YY = SD(NP1)                                                      7480
      A=100.*RMAX+.005                                                  7490
      AV(IPIV)=A                                                        7500
      I=100.*A                                                          7510
      A=I                                                               7520
      TOT=TOT+A/100.                                                    7530
      DO 19 I=1,IPIV                                                    7540
      K=IORD(I)                                                         7550
      B(I)=YY*S(I,NP1)/SD(K)                                            7560
      DISC2-SQRT(SMD*S(I,I)/CR(K))                                      7570
      IF(DISC2)54,55,55                                                 7580
   54 WRITE(IO,56)DISC2                                                 7590
   56 FORMAT(1H0,"SECOND SQUARE ROOT IS NEGATIVE AND =",E17.10)         7600
   55 CONTINUE                                                          7610
      SEB(I)=SQRT (SMD*S(I,I)/CR(K))                                    7620
      T(I)=B(I)/SEB(I)                                                  7630
   19 BO=BO-B(I)*SUM(K)                                                 7640
C                                                                       7650
      FPIV=IPIV                                                         7660
      SMR=SSR/FPIV                                                      7670
      F=SMR/SMD                                                         7680
      IF (SMD)57,57,58                                                  7690
   57 WRITE(IO,59)SMD                                                   7700
   59 FORMAT(1H0,"SMD IS ZERO OR NEGATIVE AND =",E17.10)                7710
   58 CONTINUE                                                          7720
      A=SQRT (SMD)                                                      7730
C                                                                       7740
C ***    IF    IO    INPUT    AS    NEGATIVE,   PRINT ONLY FOR LAST STAGE 7750
C                                                                       7760
      IF( IOT.LE. 0   .AND.  IPIV . NE. NP)  GO TO 24                   7770
C     IF((IPIV / 2 * 2 ) .NE. IPIV  .OR.  IPIV .GE.12)   WRITE(IO, 998) 7780
998   FORMAT("1")                                                       7790
C     WRITE(IO, 999)                                                    7800
C                                                                       7810
      WRITE(IO,20)IPIV,BO                                               7820
   20 FORMAT(17H REGRESSION STAGE,I3,10X,16HCONSTANT TERM = ,E17.10//1067830
     1H VARIABLE  ORDER  REGRESSION COEFT   STANDARD ERROR OF COEFT  T-V7840
     2ALUE FOR COEFT=0  PROPORTION OF VARIATION/)                       7850
      DO 21 I=1,IPIV                                                    7860
C     IF(IPIV.EQ.NOIND)PUNCH 492,IORD(I),B(I)                           7870
  492 FORMAT(I2,3X,E17.10)                                              7880
   21 WRITE(IO,22)IORD(I),I,B(I),SEB(I),T(I),AV(I)                      7890
   22 FORMAT(3X,I3,6X,I3,3X,E17.10,2X,E17.10,8X,E17.10,4X,E17.10)       7900
C     IF(IPIV.EQ.NOIND)PUNCH 493,BO                                     7910
  493 FORMAT(5X,E17.10)                                                 7920
      WRITE(IO,23)IPIV,SSR,SMR,F,IDFD,SSD                               7930
   23 FORMAT(4H0DFR,8X,3HSSR,17X,3HMSR,18X,1HF,11X,3HDFE,7X,3HSSE/1X,I3,7940
     13X,E17.10,3X,E17.10,3X,E17.10,1X,I4,3X,E17.10)                    7950
      WRITE(IO,25)SMD,IDFT,SST,TOT,A                                    7960
   25 FORMAT(1H0,8X,3HMST,10X,3HDFT,7X,3HSST,17X,3HTOT,17X,3HSED/4X,E17.7980
     110,1X,I4,1X,3(E17.10,3X))                                         7990
24    CONTINUE                                                          8000
```

```
      DO 40 I=1,NP
      IF(I.EQ.IORD(J))BORD(I)=B(J)
   40 CONTINUE
      WRITE(9)B0,(BORD(I),I=1,NP)
C ****    PLOT-BACK UPON REQUEST                                          8010
C                                                                         8020
      IF(IPLOT.NE.4.AND.IPLOT.NE.3)GO TO 1221                             8030
      WRITE(IO,26)                                                        8040
   26 FORMAT (10H0 PLOTBACK//// "   OBSERVED DEPENDENT  CALCULATED DEPEN8050
     1DENT  DIFFERENCE(OBS - CALC)        PER-CENT"//)                    8060
      KNT=0                                                               8070
      SUMSQ=0                                                             8080
      DO 28 I=1,N                                                         8090
      READ(LUN) (X(J), J = 1, NP), (Y(J), J = 1, NODEP), WT               8100
      XNP1 = Y(IJKLM)                                                     8110
      SAVE=B0                                                             8120
      DO 27 J=1,NP                                                        8130
      K=IORD(J)                                                           8140
   27 SAVE=SAVE+B(J)*X(K)                                                 8150
      YY = XNP1 - SAVE                                                    8160
      ANP1 = ABS(XNP1)                                                    8170
      IF(ANP1 .LE. 1.E-10)  GO TO 2000                                    8180
      PCT = YY / XNP1 * 100.                                              8190
      GO TO 2222                                                          8200
 2000 PCT = -10000000000.                                                 8210
 2222 CONTINUE                                                            8220
      IF(IPLOT.EQ.3)GO TO 31                                              8230
      WRITE(IO,29)XNP1,  SAVE,YY, PCT                                     8240
   29 FORMAT(3X,E17.10,3X,E17.10,5X,E17.10, 5X,  F 15.2)                  8250
   31 CONTINUE                                                            8260
      SUMSQ=SUMSQ+YY*YY                                                   8270
      KNT=KNT+1                                                           8280
   28 CONTINUE                                                            8290
      SIG=SQRT(SUMSQ/(KNT-2))                                             8300
      WRITE(IO,30)SIG                                                     8310
   30 FORMAT(1H0,"STANDARD DEVIATION=",F10.1)                             8320
      REWIND LUN                                                          8330
 1221 CONTINUE                                                            8340
 1220 CONTINUE                                                            8350
      GO TO 7777                                                          8360
C                                                                         8370
C **     R E T U R N S                                                    8380
C                                                                         8390
 4444 WRITE(IO, 6666) NOTND                                               8400
 6666 FORMAT( "  NUMBER OF INDEPENDENT VARIABLES =",I8, "   IS GREATER T8410
     CHAN MAXIMUM PERMITTED OF 50")                                       8420
      GO TO 7777                                                          8430
 5555 WRITE(IO, 8888) NODEP                                               8440
 8888 FORMAT( "  NUMBER OF DEPENDENT VARIABLES =",I8,  "    IS GREATER T8450
     CHAN MAXIMUM PERMITTED OF 100")                                      8460
 7777 CONTINUE                                                            8470
      REWIND LUN                                                          8480
      RETURN                                                              8490
      END                                                                 8500
      SUBROUTINE SELSTN(ID,NAME,LATGR,LONGGR,LATGM,LONGGM)                4350
C                                                                         4360
C.....THIS SUBROUTINE PERFORMS A TABLE LOOK UP FOR NAME GEOGRAPHIC        4370
C.....AND GEOMAGNETIC CO-ORDINATES OF A STATION FROM GIVEN ID)            4380
      DIMENSION NCR(36),LAGR(36),LAGM(36),LOGR(36),LOGM(36),ICODE(36)
      DATA NCR/10HOTTAWA    ,10HST.JOHNS  ,10HMEANOOK   ,10HVICTORIA  , 4410
     110HCHURCHILL ,10HBAKER LAKE,10HCAMBRIDGE ,10HGW. RIVER ,            4420
     210HRESLT. BAY  ,10HYEL. KNIFE,10HWHITESHELL,10HALERT     ,          4430
     310HGLENLEA   ,10HMOULD BAY ,10HPELLY BAY ,10HRANKIN ILT,            4440
     410HESKIMO PNT,10HBACK      ,10HGILLAM    ,10HISLAND LKE,            4450
     510HTHOMPSON  ,10HFT SEVERN ,10HJOHNSON PT,10HSACHS HARB,10HCAPE PE
     6RRY,10HINUVIK    ,10HARCTIC VIL,10HFT YUKON  ,10HCOLLEGE   ,  10HT
     7ALKEETNA ,10HNORMAN WEL,10HFT SIMPSON,10HFT SMITH  ,10HLYNN LAKE ,
     810HBOULDER   ,10H NO STN   /
      DATA LAGR/7H 45.4 N,7H 47.6 N,7H 54.6 N,7H 48.5 N,7H 58.8 N,        4470
     17H 64.3 N,7H 69.1 N,7H 55.3 N,7H 74.7 N,7H 62.5 N,                  4480
     27H 49.75N,7H 82.5 N,7H 49.6 N,7H 76.2 N,7H 68.5 N,7H 62.8 N,        4490
     37H 61.1 N,7H 57.7 N,7H 56.4 N,7H 53.9 N,7H 55.7 N,7H 56.0 N,
     47H 72.46N,7H 72.00N,7H 70.15N,7H 68.35N,7H 68.13N,7H 66.57N,
     57H 64.88N,7H 63.30N,7H 65.28N,7H 61.87N,7H 60.00N,7H 56.85E,
     67H 40.13N,7H          /
      DATA LAGM/7H 57.0 N,7H 58.7 N,7H 61.9 N,7H 54.3 N,7H 68.8 N,        4510
     17H 73.9 N,7H 76.7 N,7H 66.8 N,7H 83.1 N,7H 69.1 N,                  4520
     27H 59.9 N,7H 85.7 N,7H 59.5 N,7H 79.1 N,7H 78.7 N,7H 73.0 N,        4530
     37H 71.1 N,7H 67.8 N,7H 66.5 N,7H 64.0 N,7H 65.4 N,7H 66.9 N,
     47H 76.94N,7H 75.20N,7H 73.89N,7H 70.60N,7H 68.09N,7H 66.80N,
     57H 64.77N,7H 62.96N,7H 69.31N,7H 67.31N,7H 67.31N,7H 66.00N,
     57H 49.04N,7H          /
      DATA LOGR/7H 75.55W,7H 52.7 W,7H113.3 W,7H123.4 W,7H 94.1 W,        4550
     17H 96.0 W,7H105.0 W,7H 77.75W,7H 94.9 W,7H114.5 W,                  4560
     27H 95.25W,7H 62.5 W,7H 97.1 W,7H119.4 W,7H 89.8 W,7H 92.1 W,        4570
     37H 94.1 W,7H 94.2 W,7H 94.7 W,7H 94.7 W,7H 97.9 W,7H 87.6 W,
     47H118.30W,7H125.30W,7H124.67W,7H133.72W,7H145.57W,7H145.28W,
     57H148.05W,7H150.10W,7H126.85W,7H121.38W,7H111.98W,7H101.05W,
     67H105.33W,7H          /
      DATA LOGM/7H351.5 E,7H 21.4 E,7H300.7 E,7H292.7 E,7H322.5 E,        4590
     17H314.8 E,7H294.0 E,7H347.2 E,7H287.7 E,7H292.6 E,                  4600
     27H325.2 E,7H168.7 E,7H323.0 E,7H255.4 E,7H318.4 E,7H322.2 E,         4610
     37H320.8 E,7H323.0 E,7H323.1 E,7H324.4 E,7H319.3 E,7H333.0 E,
     47H271.66E,7H266.15E,7H270.99E,7H265.60E,7H255.35E,7H257.64E,
     57H257.14E,7H256.91E,7H276.94E,7H286.91E,7H299.82E,7H315.87E,
     67H317.40E,7H          /
      DATA ICODE/45204,42307,35245,41237,31266,26264,21255,               4630
     135282,15265,28246,40265,007298,40263,14241,21270,27268,              4
     229266,32266,34265,36265,34262,34272,17241,18235,20235,22226,22214,
     323215,25212,28210,25233,28239,30248,33259,50255,000000/
```

```
      DO 10 JJ=1,35
      IF(ID.NE.ICODE(JJ)) GO TO 10
      ISTN=JJ
      GO TO 20
   10 CONTINUE
      ISTN=36
      IF(ID.EQ.35242.OR.ID.EQ.35247) ISTN=3
      IF(ID.EQ.25255) ISTN=7
   20 NAME=NCR(ISTN)
      LATGR=LAGR(ISTN)
      LONGGR=LOGR(ISTN)
      LATGM=LAGM(ISTN)
      LONGGM=LOGM(ISTN)
      RETURN
      END
      SUBROUTINE QBLSV(ID,JYR,JDAY,NAME,QBL,SV)
C     JK WALKER EPB/EMR OTTAWA 613-995-5545
CTHIS ROUTINE DETERMINES THE UNDISTURBED BASELINES FOR THE OBSERVATORIES
C     FROM THE SECLAR VARIATION COEFFICIENTS FOR EACH OBS.
C....AND FOR QUIET BASELINES AND SV FOR EACH COMPONENT
C     FOR THE PERIOD 1973-1981 FOR MOST OBSERVATORIES
      DIMENSION ICODE(14),QBC(14,3),SVL(14,3),SVQ(14,3),SVC(14,3),
     1NCR(14),QBL(3),SV(3)
      DATA NCR/"BAKER LAKE","RESOLUTE B","MOULD BAY ","MEANOOK   ",
     1"VICTORIA  ","WHITESHELL","GT WHALE  ","OTTAWA    ","YELLOWKNIF",
     2"ST JOHNS  ","ALERT     ","FT CHURCHI","CAMBRIDGE ","NO STATION"/
      DATA QBC/  107.4841, -797.4972, 2202.7351, 5301.0283, 7187.0707,
     1  427.7040,-3328.7344,-3810.1105, 4518.5803,-7898.7719,-2159.5410,
     1  452.0853, 1422.6944,    0.0000, 4112.1774,  246.4428, 1083.6016,
     112156.1924,17525.4845,10130.8516, 9385.7159,15180.1366, 6808.4469,
     115583.9448, 2748.5289, 6985.0020, 2465.1063,    0.0000,60282.9637,
     158131.9244,57895.8519,58589.9261,53088.5162,60297.4036,59339.5442,
     156389.7619,59922.6048,50808.6290,53400.3173,60707.8406,59844.1265,
     1    0.0000/
      DATA SVL/ 110.55887,  53.67897,  72.44209,  23.30798,  24.40187,
     1 432.38133, -21.45849,  11.12564, -64.38755, -12.67887,-390.52621,
     1  35.91395,  66.99473,   0.00000,  80.13141, -16.03955,  22.76144,
     1  22.88171,  17.96928,1247.24270,  56.58437, 187.21916, 248.49159,
     1 153.75538,-622.57788,  62.78612,    .91032,   0.00000, 201.15595,
     1 123.18592, 122.97162,  46.80301,   5.54649,-440.25791,  82.24945,
     1  35.93151, 116.55496,  -4.48158, 856.47479,  86.22049,  81.16815,
     1    0.0000/
      DATA SVQ/-16.425953, -7.260751,-10.800300, -7.225167, -6.824538,
     1-53.161852,   .195269, -5.371436,  2.946493,  4.710876, 34.560726,
     1 -7.961086,-10.861396,  0.000000, -5.522173,  6.340231,   .614591,
     1  3.717338,   .440615,-136.68133,  1.891852,-13.667809,-23.835257,
     1 -6.603739, 63.843973,  -.599952,  5.138731,  0.000000,-25.579327,
     1-11.119302,-12.026542, -7.881895, -3.844183, 45.669404,-13.251919,
     1-18.018825,-13.619300, -8.399165,-90.849507,-12.363493, -7.866929,
     1    0.0000/
      DATA SVC/   .631219,   .251501,   .419165,   .289250,   .247690,
     1  2.753854,  -.007407,   .213936,  -.078837,  -.201915,  -.981109,
     1   .309415,   .420418,  0.000000,   .247059,  -.274483,  -.092175,
     1  -.250593,  -.051522,  5.102739,  -.104780,   .462138,   .815744,
     1   .179470, -2.079473,  -.015883,  -.258371,  0.000000,   .924437,
     1   .267257,   .346171,   .253457,   .136095, -1.832160,   .365141,
     1   .713950,   .449813,   .260800,  3.052061,   .383221,   .193629,
     1    0.0000/
      DATA ICODE/26264,15265,14241 ,35245,41237,40265,35282,45284,28246,
     142307,07298,31266,21255,00000/
      DO 10 JJ=1,13
      IF(ID.NE.ICODE(JJ)) GO TO 10
      ISTN=JJ
      GO TO 20
   10 CONTINUE
      ISTN=14
      IF(ID.EQ.35242.OR.ID.EQ.35247) ISTN=4
      IF(ID.EQ.25255) ISTN=7
   20 QDAY=JYR+JDAY/365.25-1970.
      QDAYS=QDAY*QDAY
      DO 15 IC=1,3
      QBL(IC)=QBC(ISTN,IC)+SVL(ISTN,IC)*QDAY+SVQ(ISTN,IC)*QDAYS
     1+SVC(ISTN,IC)*QDAY*QDAYS
      SV(IC)=SVL(ISTN,IC)+2.*SVQ(ISTN,IC)*QDAY+3.*SVC(ISTN,IC)*QDAYS
   15 CONTINUE
      IF(ID.NE.26264.OR.JYR.GT.1977) GO TO 40
   30 QBL(3)=QBL(3)-60.
      QBL(2)=QBL(2)-5.
      GO TO 60
   40 IF(ID.NE.42307.OR.JYR.GT.1966) GO TO 60
   50 QBL(1)=QBL(1)+3.
      QBL(2)=QBL(2)-3.
      QBL(3)=QBL(3)-3.
   60 NAME=NCR(ISTN)
      END
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      PROGRAM FBLSV(INPUT=100,TAPE1,OUTPUT=300,TAPE5=INPUT,TAPE6=OUTPUT,
     1TAPE9=512,TAPE8,TAPE7=300)
C   JK WALKER EPB  PH 995-5545
C   THIS PROGRAM DETERMINES THE SECULAR VARIATION FROM THE
C   UNDISTURBED LEVELS AND PLOTS IT TOGETHER WITH THE LEVELS
C    ANNUAL MEANS ARE ALSO READ IN AND PLOTTED
C    SUBS REQD; CALCOMP PLOT & SYMBOL, CLDATE, ACSO15, YLINPL, TES
C FOR EACH STATION WE HAVE ON INPUT:
C    1) THE QUIET DAYS
C    2) BLANK CARD
C    3) ANNUAL MEANS
C    4) BLANK CARD
C    5) QUIET DAY MEANS
C    6) BLANK CARD
C    7) *EOR CARD
      INTEGER TC,XC,YC,ZC,FA
      DIMENSION XP(40),TP(40),X(200,3),XMAX(3),XMIN(3),T(200),ITA(2),BUF
     1(1),XA(20,3),TA(20),NTA(15),XB(20,3),F(20),ZAA(3)
     2,TQ(20),XQ(20,3),BP(15,3,4),ZAQ(3)
      REAL LAT,LONG
      DATA PLX,PLO,PLA,PLC,PC2,PC3,XSH,XDIV,YSH,YDIV,IPLOT,NOIND,NODEP/
     1     0.0,2.0,0.9,-3.,-5.,-12.,5.6,12.7,3.1,12.7,    4,   3,    3/
      NOIND2=2
C INITIALIZE PLOTTER
      CALL PLOTS(BUF,1)
      CALL PLOT(1.5,0.9,-3)
C     CALL FACTOR(0.635)
C NO COUNTS THE NUMBER OF QUIET DAYS: NSTN COUNTS THE NUMBER OF STATIONS
      NSTN=0
    5 WT=NO=NA=NQ=1
      NSTN=NSTN+1
      PRINT 205
  205 FORMAT('1 QUIET NIGHTTIME LEVELS')
    1 PRINT 220
  220 FORMAT('  NO IC SO COUN   STATION NAME   ALT      LAT       LONG
     1DATE      MTH  DAY     Y          X          Z         F       CARD')
C
C   READ IN QUIET DAYS
C COU IS THE COUNTRY
C ITA IS THE STATION NAME
C T IS THE TIME OF THE QUIET DAY
C THE VALUES OF T,Y,X AND Z ARE PUT IN AN ARRAY
    2 READ(1,100,END=999)IC,SOUR,COU,ITA,ALT,LAT,LONG,T(NO),X(NO,3)
     1,X(NO,2),X(NO,1),F(1),ICRD
  100 FORMAT(I1,R3,R4,A10,A7,F4.0,F6.3,F7.3,F8.3,F7.0,6X,F5.0,F6.0,F5.0
     1,I6)
C IF THE TIME IS NEGATIVE: RESTART
C IF THE TIME IS ZERO     : READ ANNUAL MEANS
C IF THE TIME IS POSITIVE: PROCESS THAT QUIET DAY
      IF(T(NO))5,99,3
    3 JYR=T(NO)
      YEAR=365.
      IF(MOD(JYR,4).EQ.0)YEAR=366.
      IDAY=(T(NO)-JYR)*YEAR+.5
C GET DATE OF THE MONTH FROM SEQUENTIAL DAY OF THE YEAR
      CALL CLDATE(IDAY,JYR,MNTH,IDAE)
      PRINT 200,NO,IC,SOUR,COU,ITA,ALT,LAT,LONG,T(NO),MNTH,IDAE,X(NO,3),
     1X(NO,2),X(NO,1),F(1),ICRD
  200 FORMAT(' ',I3,I2,1X,R3,1X,R4,1X,A10,A7,F5.0,F8.3,2F10.3,1X,A5,I3,
     14F8.0,I8)
      T(NO)=T(NO)-1970.
      IF(NO.GT.198) GO TO 98
      NO=NO+1
      GO TO 2
   98 PRINT 250,NO
  250 FORMAT(' ',I3,'DAYS GT DIMENSION')
   99 XMIN(1)=  IN(2)=XMIN(3)=70000.
      XMAX(1)=XMAX(2)=XMAX(3)=-50000.
      NO=NO-1
C
C     READ IN ANNUAL MEANS
    7 PRINT 260
      PRINT 220
  260 FORMAT('0 ANNUAL MEANS')
    8 READ(1,110,END=999)IC,SOUR,COU,ITA,LAT,LONG,TA(NA),XA(NA,3),XM,XAN
     1A,XA(NA,1),F(NA),ICRD
      ICA=IC
      COUA=COU
  110 FORMAT(I1,R3,R5,A10,A2,F6.3,F7.3,4X,F5.1,F4.0,F3.1,6X,F5.0,F6.0,
     1F5.0,8X,I6)
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```
      C IF THE TIME IS NEGATIVE : RESTART
      C IF THE TIME IS ZERO     : DO ANALYSIS
      C IF THE TIME IS POSITIVE : PROCESS ANNUAL MEANS
            IF(TA(NA))5,14,12
         12 XA(NA,3)=XA(NA,3)+SIGN(XM,XA(NA,3))/60.
            XA(NA,2)=XANA*COSD(XA(NA,3))
            XA(NA,3)=XANA*SIND(XA(NA,3))
            SOURA=SOUR
            NTA(NSTN)=ITA(1)
      C XMAX CONTAINS THE MAXIMUM VALUE OF X FROM THE QUIET DAY AND ANNUAL MEA
      C XMIN CONTAINS THE MINIMUM VALUE OF X FROM THE QUIET DAY AND ANNUAL MEA
            DO 11 IZXY=1,3
            XMAX(IZXY)=AMAX1(XMAX(IZXY),XA(NA,IZXY))
         11 XMIN(IZXY)=AMIN1(XMIN(IZXY),XA(NA,IZXY))
            PRINT 210,NA,IC,SOUR,COU,ITA,LAT,LONG,TA(NA),XA(NA,3),XA(NA,2),XA(
           1NA,1),F(NA),ICRD
        210 FORMAT(' ',I3,I2,1X,R3,1X,R5,1X,A10,A2,9X,F8.3,2F10.3,9X,4F8.0,I9)
            TA(NA)=TA(NA)-1970.
            NA=NA+1
            PLAT=LAT
            PLONG=LONG
            LITA=ITA(1)
            GO TO  8
         14 NA=NA-1
      C
      C     READ IN QUIET MEANS
            PRINT 270
            PRINT 220
        270 FORMAT('0 QUIET DAY MEANS')
          9 READ(1,120,END=999)IC,SOUR,COU,ITA,LAT,LONG,TQ(NQ),XQ(NQ,3),XM,XQ(
           1NQ,2),XQ(NQ,1),F(NQ),ICRD
        120 FORMAT(I1,R3,R5,A10,A2,F6.3,F7.3,4X,F5.1,F5.0,F2.0,6X,F5.0,F6.0,
           1F5.0,8X,I6)
            ICA=IC
            COUA=COU
      C IF THE TIME IS NEGATIVE : RESTART
      C IF THE TIME IS ZERO     : DO ANALYSIS
      C IF THE TIME IS POSITIVE : PROCESS ANNUAL MEANS
            IF(TQ(NQ))5,15,13
         13 SOURA=SOUR
            DO 24 IZXY=1,3
            XMAX(IZXY)=AMAX1(XMAX(IZXY),XQ(NQ,IZXY))
         24 XMIN(IZXY)=AMIN1(XMIN(IZXY),XQ(NQ,IZXY))
            PRINT 210,NQ,IC,SOUR,COU,ITA,LAT,LONG,TQ(NQ),XQ(NQ,3),XQ(NQ,2),
           1XQ(NQ,1)
           1,F(NQ),ICRD
            TQ(NQ)=TQ(NQ)-1970.
            NQ=NQ+1
            PLONG=LONG
            LITA=ITA(1)
            GO TO 9
         15 NQ=NQ-1
      C
            AC=1HZ
            PG=PLX
      C    CUBIC ANALYSIS
         16 DO 90 I=1,NQ
            T2=T(I)*T(I)
            T3=T2*T(I)
         90 WRITE(8)T(I),T2,T3,X(I,1),X(I,2),X(I,3),WT
            PRINT 205
            CALL ACS015(NQ,NOIND,NODEP,0,8,-6)
      C
            REWIND(9)
      C
            DO 1000 IZXY=1,3
            DO 30 I=1,NQ
            XMAX(IZXY)=AMAX1(XMAX(IZXY),X(I,IZXY))
         30 XMIN(IZXY)=AMIN1(XMIN(IZXY),X(I,IZXY))
            T1=IT1=T(1)
            IT2=T(NQ)+.8
            NY=TDPL=(IT2-IT1)*2.
            NY=NY+1
            TP(1)=T(1)
            TP(2)=T(NQ)
            XP(1)=XMIN(IZXY)
            XP(2)=XMAX(IZXY)
            XSH=TDPL/2.54+.01
            IF(XSH.LT.3.5)XSH=2.*XSH
            CALL XLINPL(2,TP,XP,PG,XSH,XDIV,YSH,YDIV,9,9H1970+  YR,1,AC)
            CALL TES(-.25,YSH*.6,.15,90.)
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C     PLOT OBERVATIONS,QUIET AND ANNUAL MEANS
      CALL XLINPL(NO,T,X(1,IZXY),PLC,XSH,XDIV,YSH,YDIV,0,0,0,0)
      CALL XLINPL(NA,TA,XA(1,IZXY),PC2,XSH,XDIV,YSH,YDIV,0,0,0,0)
      CALL XLINPL(NQ,TQ,XQ(1,IZXY),PC3,XSH,XDIV,YSH,YDIV,0,0,0,0)
      TT=T1
C     CALC AND PLOT REGRESSION ANNALYSIS
      READ(9)B0,B1,B2,B3
      DO 10 I=1,NY
      TP(I)=TT
      T2=TT*TT
      XP(I)=B0+B1*TP(I)+B2*T2+B3*T2*TT
   10 TT=TT+.5
      PRINT 240, XMIN(IZXY),XMAX(IZXY),XP(1),XP(NY),B0,B1,B2,B3,(X(I,IZX
     1Y),I=1,9)
  240 FORMAT(' ',5F7.0,F10.3,13F7.0)
      CALL XLINPL(NY,TP,XP,PLO,XSH,XDIV,YSH,YDIV,0,0,0,0)
C     DETERMINE DIFFERENCE OF OBSERVATIONS AND ANALYSIS
      XMAX(IZXY)=XMIN(IZXY)=-9.9
      DO 18 I=1,NO
      T2=T(I)*T(I)
      ZC=B0+B1*T(I)+B2*T2+B3*T2*T(I)
      X(I,IZXY)=X(I,IZXY)-ZC
      XMIN(IZXY)=AMIN1(XMIN(IZXY),X(I,IZXY))
   18 XMAX(IZXY)=AMAX1(XMAX(IZXY),X(I,IZXY))
C    DETERMINE DIFFERENCE OF ANNUAL MEANS AND REGRESSION CURVE
      ZAA(IZXY)=ZAQ(IZXY)=0.0
      DO 19 I=1,NA
      T2=TA(I)*TA(I)
      ZAC=B0+B1*TA(I)+B2*T2+B3*T2*TA(I)
      XA(I,IZXY)=XA(I,IZXY)-ZAC
      XMIN(IZXY)=AMIN1(XMIN(IZXY),XA(I,IZXY))
      XMAX(IZXY)=AMAX1(XMAX(IZXY),XA(I,IZXY))
      ZAA(IZXY)=ZAA(IZXY)+XA(I,IZXY)
   19 XB(I,IZXY)=ZAC
      ZAA(IZXY)=ZAA(IZXY)/NA
C    DETERMINE DIFFERENCE OF QUIET MEANS AND REGRESSION CURVE
      DO 21 I=1,NQ
      T2=TQ(I)*TQ(I)
      ZAC=B0+B1*TQ(I)+B2*T2+B3*T2*TQ(I)
      XQ(I,IZXY)=XQ(I,IZXY)-ZAC
      XMIN(IZXY)=AMIN1(XMIN(IZXY),XQ(I,IZXY))
      XMAX(IZXY)=AMAX1(XMAX(IZXY),XQ(I,IZXY))
   21 ZAQ(IZXY)=ZAQ(IZXY)+XQ(I,IZXY)
      ZAQ(IZXY)=ZAQ(IZXY)/NQ
      BP(NSTN,IZXY,1)=B0
      BP(NSTN,IZXY,2)=B1
      BP(NSTN,IZXY,3)=B2
      BP(NSTN,IZXY,4)=B3
      AC=1HX
      IF(IZXY.EQ.2)AC=1HY
 1000 PG=0.1
      CALL SYMBOL(1.0,YSH+.2,.25,LITA,0.0,10)
C     PUNCH UNDISTURBED LEVELS
      LABEL=4H UBL
      ILAT=PLAT*1000.
      ILONG=PLONG*1000.
      DO 41 I=1,NA
      F(I)=SQRT(XB(I,3)**2+XB(I,2)**2+XB(I,1)**2)
      TC=(TA(I)+1970.)*10
      FA=F(I)*1.
       XC=XB(I,2)*1.
       YC=XB(I,3)*1.
       ZC=XB(I,1)*1.
   41 WRITE(7,310) ICA,SOURA,COUA,LITA,LABEL,ILAT,ILONG,TC,YC,
     *XC,ZC,FA
  310 FORMAT(I1,R3,R4,A10,A10,1X,I6,I7,I8,I7,6X,I5,I6,I5)
C    PRINT AND PUNCH DISTURBED AND QUIET DAY MEANS
      PRINT 300,LITA,PLAT,PLONG,ZAA(3),ZAA(2),ZAA(1)
      PRINT 300,LITA,PLAT,PLONG,ZAQ(3),ZAQ(2),ZAQ(1)
      WRITE(7,300)LITA,PLAT,PLONG,ZAA(3),ZAA(2),ZAA(1)
      WRITE(7,300)LITA,PLAT,PLONG,ZAQ(3),ZAQ(2),ZAQ(1)
  300 FORMAT(6X,A10,F6.3,F8.3,3F7.1)
C
C    PLOT DIFFERENCES FROM REGRESSION ANALYSIS
      AC=1HZ
      PG=PLX
```

```
      DO 2000 IZXY=1,3
      TP(1)=T(1)
      TP(2)=T(NO)
      XP(1)=XMIN(IZXY)
      XP(2)=XMAX(IZXY)
      CALL XLINPL(2,TP,XP,PG,XSH,XDIV,YSH,YDIV,9,9H1970+  YR,1,1HX)
      CALL TES(-.25,YSH*.6,.15,90.)
      CALL XLINPL(NO,T,X(1,IZXY),PLC,YSH,XDIV,YSH,YDIV,0,0,0,0)
      CALL XLINPL(NA,TA,XA(1,IZXY),PC2,XSH,XDIV,YSH,YDIV,0,0,0,0)
      CALL XLINPL(NQ,TQ,XQ(1,IZXY),PC3,XSH,XDIV,YSH,YDIV,0,0,0,0)
      XP(1)=XP(2)=0.0
      CALL XLINPL(2,TP,XP,PLO,XSH,XDIV,YSH,YDIV,0,0,0,0)
      AC=1HX
      IF(IZXY.EQ.2)AC=1HY
 2000 PG=0.1
      CALL SYMBOL(1.0,YSH+.2,.25,LITA,0.0,10)
C
C     PLOT VALUES ON ANNUAL SCALE AND DO QUADRATIC ANALYSIS
      REWIND 8
      DO 40 I=1,NO
      IT=T(I)
   40 T(I)=T(I)-IT
      DO 42 I=1,NO
      T2=T(I)*T(I)
C     PRINT 230,I,T(I),X(I,3),X(I,2),X(I,1)
   42 WRITE(9)T(I),T2,X(I,1),X(I,2),X(I,3),WT
  230 FORMAT(' ',I3,F6.3,3F6.1)
      CALL ACS015(NO,NOIND2,NODEP,0,8,-6)
      REWIND(9)
      XSHY=3.95
      NY=10
      AC=1HZ
      PG=PLX
C
      DO 3000 IZXY=1,3
      TP(1)=T1=0.01
      TP(2)=0.99
      XP(1)=XMIN(IZXY)
      XP(2)=XMAX(IZXY)
      CALL XLINPL(2,TP,XP,PG,XSHY,XDIV,YSH,YDIV,4,4HTIME,1,AC)
      CALL TES(-.25,YSH*.6,.15,90.)
      CALL XLINPL(NO,T,X(1,IZXY),PLC,XSHY,XDIV,YSH,YDIV,0,0,0,0)
      TT=T1
      READ(9)B0,B1,B2
      DO 60 I=1,NY
      TP(I)=TT
      XP(I)=B0+B1*TT+B2*TT*TT
   60 TT=TT+.1
      CALL XLINPL(NY,TP,XP,PLO,XSHY,XDIV,YSH,YDIV,0,0,0,0)
      PRINT 240,XMIN(IZXY),XMAX(IZXY),XP(1),XP(2),B0,B1,B2,(XP(I),I=1,1
     1)
      AC=1HX
      IF(IZXY.EQ.2)AC=1HY
 3000 PG=0.1
      CALL SYMBOL(1.0,YSH+.2,.25,LITA,0.0,10)
      IF(NSTN.LT.2)GO TO 5
C    PUNCH COEFFICIENTS FOR SUBROUTINE OBLSV
  999 WRITE(7,320)(NTA(NS),NS=1,NSTN)
      PRINT 325,(NTA(NS),NS=1,NSTN)
  320 FORMAT(6X,'DATA NCP/',4('"',A10,'",'),/,(5X,'1',5('"',A10,'",')))
  325 FORMAT(' ',12A11)
      WRITE(7,330)((BP(NS,JC,1),NS=1,NSTN),JC=1,3)
      PRINT 335,((BP(NS,JC,1),NS=1,NSTN),JC=1,3)
  330 FORMAT(6X,'DATA OBC/',5(F10.4,','),/,6(5X,'1',6(F10.4,',')))
TRIVIAL  *  RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
  335 FORMAT(' ',14F9.3)
      WRITE(7,340)((BP(NS,JC,2),NS=1,NSTN),JC=1,3)
      PRINT 335,((BP(NS,JC,2),NS=1,NSTN),JC=1,3)
  340 FORMAT(6X,'DATA SVL/',5(F10.5,','),/,6(5X,'1',6(F10.5,',')))
TRIVIAL  *  RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
      WRITE(7,350)((BP(NS,JC,3),NS=1,NSTN),JC=1,3)
      PRINT 345,((BP(NS,JC,3),NS=1,NSTN),JC=1,3)
  350 FORMAT(6X,'DATA SVO/',5(F10.5,','),/,6(5X,'1',6(F10.5,',')))
TRIVIAL  *  RECORD LENGTH EXCEEDS 137 COLUMNS -- MAY EXCEED I/O DEVICE
      WRITE(7,360)((BP(NS,JC,4),NS=1,NSTN),JC=1,3)
  360 FORMAT(6X,'DATA SVC/',5(F10.6,','),/,(5X,'1',6(F10.6,',')))
      PRINT 345,((BP(NS,JC,4),NS=1,NSTN),JC=1,3)
  345 FORMAT(' ',14F9.4)
      CALL PLOT(0.0,0.0,999)
      END
```

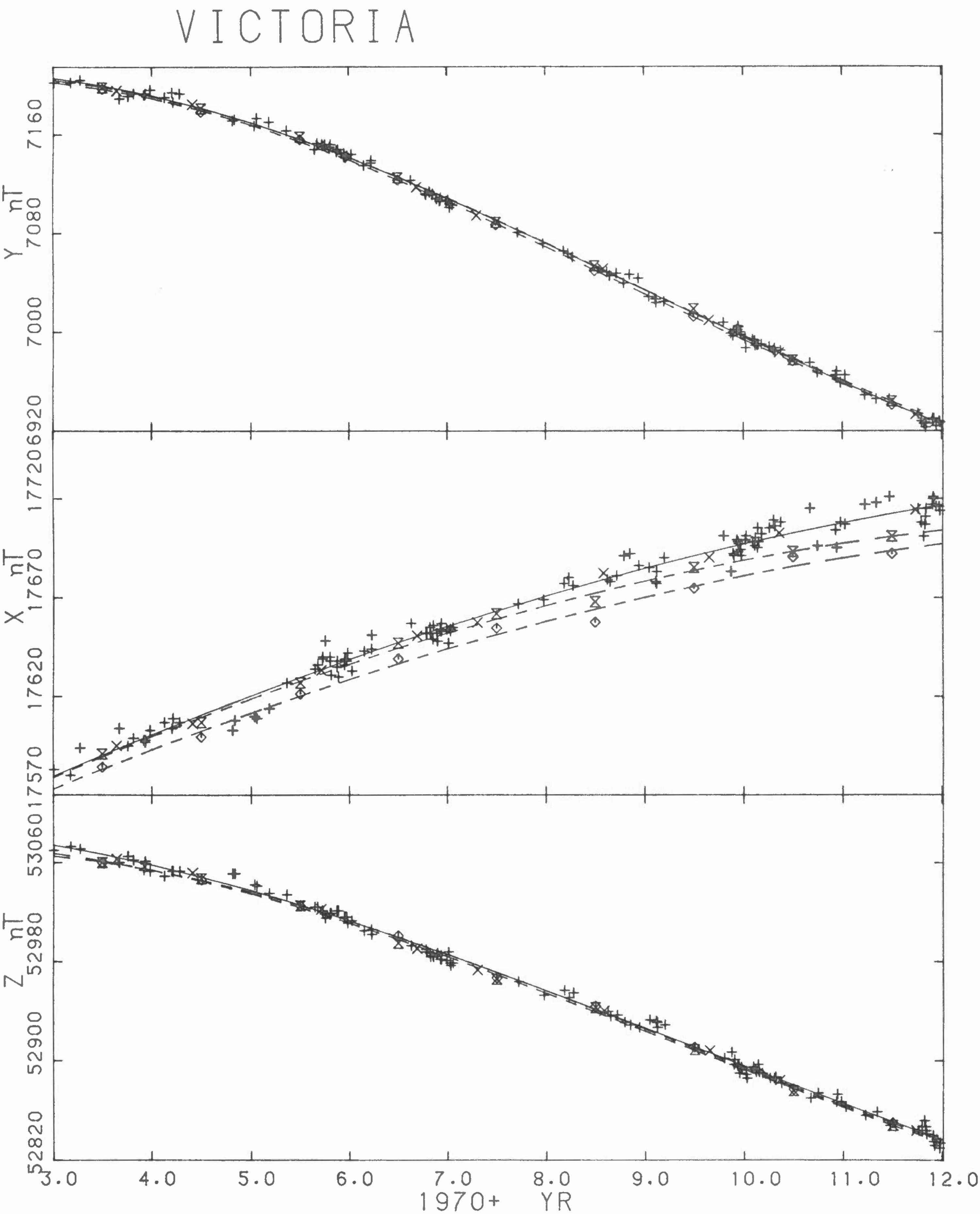
```
      PROGRAM AVSV(INPUT=65,OUTPUT=65,TAPE5=INPUT,TAPE6=OUTPUT)        180
C  JK WALKER/EPB/PH 995-5545                                           190
C  THIS PROGRAM PLOTS DIFFERENCE OF ANNUAL MEANS AND UNDISTURBED LEVELS 200
C  AND THE SECULAR VARIATION FOR ALL STATIONS.                         210
      DIMENSION AX(15),AY(15),AZ(15),XP(4),YP(4),OBL(3),SV(3),PLAT(15), 220
     1BUF(1),ISTN(15),PYR(15),NAME(15)                                 230
      DATAPLN,PLO,PLOL,PLC,XLT,XDI,YLT,YDI/0.,2.,21.,-3.,6.31,12.7,3.1, 240
     112.7/                                                            250
      CALL PLOTS(BUF,1)                                                260
      CALL PLOT(1.5,0.5,-3)                                            270
      NSTN=13                                                          280
C   PLOT QUIET AND ALL DAY AVERAGES                                    290
      XP(1)=50.                                                        300
      XP(2)=89.                                                        310
      YP(1)=-39.                                                       320
      YP(2)=29.                                                        330
      CALLXLINPL(2,XP,YP,PLN,XLT,XDI,YLT,YDI,10,10HGEOMAG LAT,5,5HFIELD)340
      CALL TES(-.25,YLT*.65,.15,90.)                                   350
      PLG=PLO                                                          352
      DO 12 J=1,2                                                      360
      DO 10 I=1,NSTN                                                   370
      READ 100,ISTN(I),NAME(I),GLAT,GLONG,AY(I),AX(I),AZ(I)            380
  100 FORMAT(I6,A10,F6.3,F8.3,3F7.1)                                   390
      CALL SELSTN(ISTN(I),NAME1,GGLAT,GGLONG,GMLAT,GMLONG)             392
      DECODE(6,300,GMLAT)PLAT(I)                                       394
  300 FORMAT(F6.2)                                                     396
   10 PRINT 200,ISTN(I),NAME(I),PLAT(I),AY(I),AX(I),AZ(I)              400
  200 FORMAT(1H ,I8,3X,A10,F8.3,3F8.3)                                 410
      CALL XLINPL(NSTN,PLAT,AZ,PLG,XLT,XDI,YLT,YDI,0,0,0,0)            420
      CALL XLINPL(NSTN,PLAT,AX,PLG,XLT,XDI,YLT,YDI,0,0,0,0)            430
      CALL XLINPL(NSTN,PLAT,AY,PLG,XLT,XDI,YLT,YDI,0,0,0,0)            440
   12 PLG=PLG+20.                                                      450
      IC=8HZ'   /YR                                                    460
      IX=4HTIME                                                        470
      IN=4                                                             480
      K=4                                                              490
      NY=8                                                             500
C   CALC. AND PLOT SECULAR VARIATION                                   510
      DO 30 L=1,3                                                      520
      JDAY=0                                                           530
      YP(1)=-29.                                                       540
      YP(2)=29.                                                        550
      XP(1)=JYRB=1972                                                  560
      XP(2)=JYRL=1982                                                  570
      K=K-1                                                            580
      DO 18 J=JYRB,JYRL,3                                              590
      DO 15 I=1,NSTN                                                   600
      IF((ISTN(I).EQ.40265.OR.ISTN(I).EQ.07298).AND.J.LT.1977)GO TO 15 610
      CALL OBLSV(ISTN(I),J,JDAY,NAM,OBL,SV)                            620
      YP(1)=AMIN1(YP(1),SV(K))                                         630
   15 YP(2)=AMAX1(YP(2),SV(K))                                         640
   18 CONTINUE                                                         650
      XLT=(JYRL-JYRB+0.1)/2.54                                         660
      IF(K.EQ.1)YLT=3.3                                                670
      CALL XLINPL(2,XP,YP,PLN,XLT,XDI,YLT,YDI,IN,IX,8,IC)              680
      CALL TES(-.25,YLT*.45,.15,90.)                                   690
      PRINT 220,(XP(I),YP(I),I=1,4)                                    700
      PLG=PLO                                                          710
  220 FORMAT(' ',8F9.2)                                                720
      DO 25 I=1,NSTN                                                   730
      JDAY=NY=0                                                        740
      DO 20 J=JYRB,JYRL                                                750
      IF(ISTN(I).EQ.40265.AND.J.GT.1981)GO TO 20                       752
      IF((ISTN(I).EQ.40265.OR.ISTN(I).EQ.07298).AND.J.LT.1977)GO TO 20 760
      NY=NY+1                                                          762
      PYR(NY)=J                                                        770
      CALL OBLSV(ISTN(I),J,JDAY,NAM,OBL,SV)                            780
      AZ(NY)=SV(K)                                                     790
   20 CONTINUE                                                         810
      CALL XLINPL(NY,PYR,AZ,PLG,XLT,XDI,YLT,YDI,0,0,0,0)               820
      PRINT 210,ISTN(I),NAME(I),I,(PYR(J),AZ(J),J=1,NY)                830
   25 IF(I.GT.4)PLG=PLOL                                               840
      IF(I.GT.8)PLG=PLG+20.                                            850
      IC=8HX'   /YR                                                    860
  210 FORMAT(' ',I6,3X,A10,I3,16F7.1,/,' ',19F7.1)                     870
      IF(K.EQ.2)IC=8HY'   /YR                                          880
   30 PLN=0.1                                                          890
      CALL PLOT(0.0,0.0,999)                                           900
      END                                                              910
```

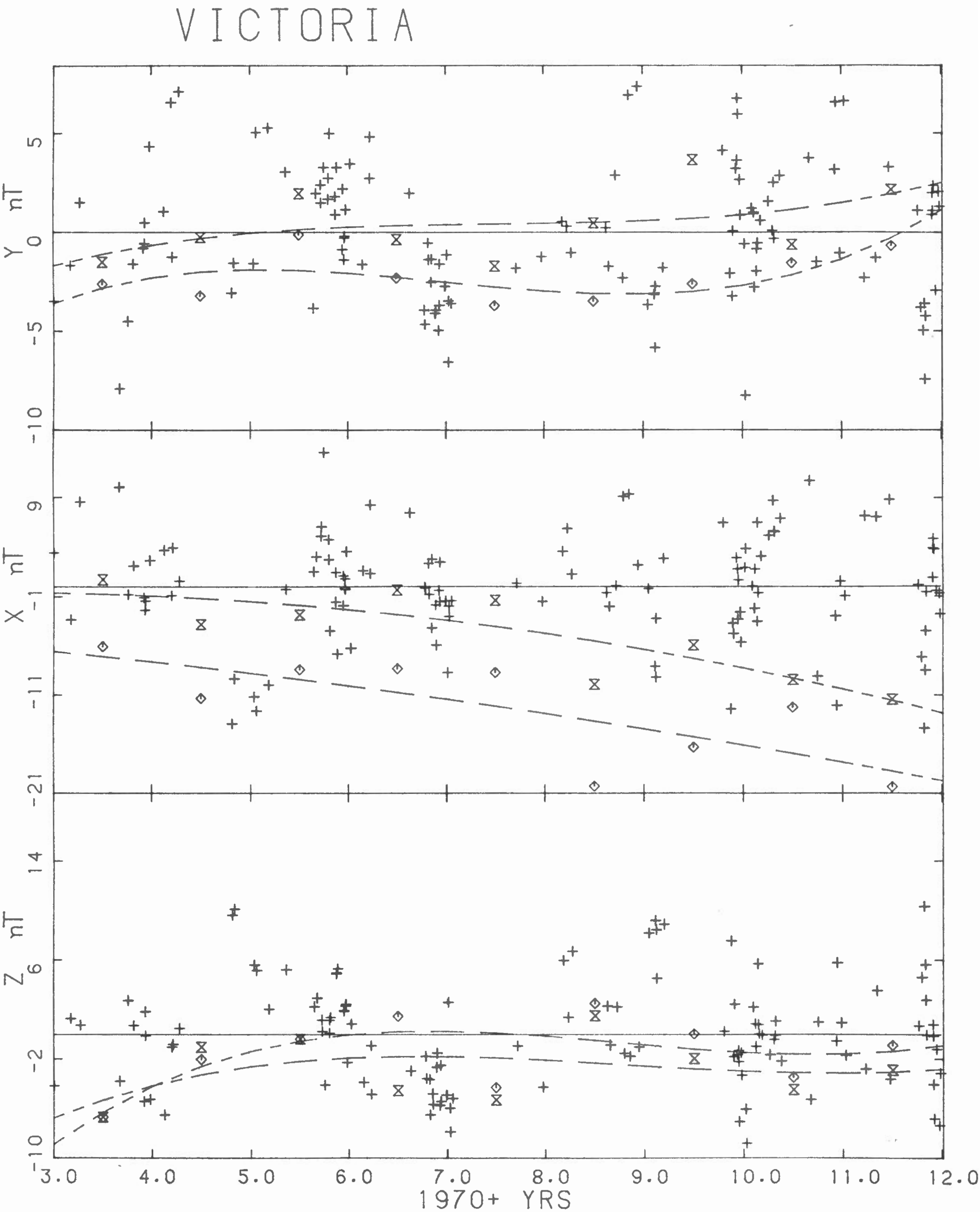
```
      PROGRAM PMULFL(INPUT=65,OUTPUT=300,TAPE1,TAPE5=INPUT,TAPE6=OUTPUT,
     1DEBUG=OUTPUT,TAPE2)
C  THIS PROGRAM PLOTS THE UNDISTURBED NIGHT TIME LEVEL OF QUIET DAY
C  AND THE MAGNETIC DATA: THE DATA CAN ALSO BE LOW PASS FILTERED
C  SUBS REQD: CALCOMP PLOTS, FILTL, REVERS, QBLSV, PLOTLB, PLOTCV
      DIMENSION QBL(3),SV(3),DAT(1440),S(1440),FI(4),BUF(1)
      COMMON IDAT(1440,4),MNVAL(4),SMARK(1440),HMK(24),SCNP(8),SCSYM(8),
     1LHDZ(3)
C  FOLLOWING COEF. FOR LOW PASS(30 MIN CUTOFF) BUTTERWORTH FILTER
C     DATA FI/-1.641066,0.677730,-1.8212110,0.852595/,G/10779.452/
C  FOLLOWING COEF. FOR LOW PASS(60 MIN CUTOFF) BUTTERWORTH FILTER
      DATA FI/-1.813870,0.823862,-1.912535,0.923071/,G/151991.036/
      INSS=10HCANADA    1
      ISCALE=2
      INDSW=JDAY=0
C    HRLN=0.7874015748
C FOR 10 CM/HR USE HRLN=0.393700
      HRLN=0.393700
      CALL PLOTS(BUF,1)
      CALL PLOT(0.5,0.5,-3)
      LHDZ(1)=10HX         1
      LHDZ(2)=10HY         1
      LHDZ(3)=10HZ         1
      ND1=IT=0
      XDEC=HRLN/60.
      DAT(1)=DAT(2)=DAT(3)=DAT(4)=0.0
      CALL FILTL(DAT,1,FI)
      PRINT 220
  220 FORMAT('1 T STN      NAME       YR    DAY  RDAY OBS  QD70  YOBL  YSV
     1XOBL  XSV   ZOBL  ZSV  FIL')
      SMARK(1)=1.4
    1 IT=IT+1
      NO=JDAY=0
C    READ IN QUIET DAYS
    2 READ(5,100,END=99)NSTMN1,IDAY,MIN,IFIL
      IF(EOF(5).NE.0) GO TO 99
  100 FORMAT(I4,I3,I4,2I2)
      IF(IDAY.EQ.0) GO TO 1
      IDAY1=IDAY-1
      DO 10 K=2,1440
   10 SMARK(K)=SMARK(K-1)+XDEC
      HMK(1)=SMARK(1440)
      DO 30 K=1,8
      DO 20 I=1,3
      J=(K-1)*3+I
      IF(J.EQ.1)GO TO 20
      HMK(J)=HMK(J-1)-HRLN
   20 CONTINUE
      M=IABS(K-9)
      SCSYM(M)=M*3.
   30 SCNP(M)=HMK(J-2)-0.1
C    SEARCH TAPE FOR DAY
      IF(JDAY-IDAY1)40,70,2
   40 READ(IT,END=99)IDENTT,JYR,JDAY,IHOR
      IF(EOF(IT).NE.0) GO TO 1
      IF(JDAY-IDAY1)40,60,2
   60 IF(IHOR-23)40,70,2
   70 DO 80 I=1,24
      K=(I-1)*60+1
      L=K+59
      READ(IT,END=99)IDENTT,JYR,JDAY,IHOR,(IDAT(J,1),IDAT(J,2),IDAT(J,3)
     1,IDAT(J,4),J=K,L)
      IF(EOF(IT).NE.0) GO TO 1
   80 CONTINUE
      NO=NO+1
      QDAY=(JYR-1970)+JDAY/365.
C  PLOT MAGNETOGRAM AND QUIET NIGHT TIME LEVEL
      CALL QBLSV(IDENTT,JYR,JDAY,NAME,QBL,SV)
      DO 82 I=1,3
   82 MNVAL(I)=QBL(I)
C  CHECK IF RESOLUTE, MOULD BAY OR ALERT AND SWITCH COMP.
      IF(IDENTT.NE.15265.AND.IDENTT.NE.007298.AND.IDENTT.NE.14241)GOTO87
      LHDZ(2)=1HX
      LHDZ(1)=1HY
   87 PRINT 210,IT,IDENTT,NAME,JYR,JDAY,IDAY,L,QDAY,(MNVAL(I),SV(I),
     1I=1,3),IFIL
  210 FORMAT(' ',I2,I6,A11,4I5,F7.3,I5,F5.1,I5,F5.1,I6,F6.1,I3)
      CALL PLOTLB(NAME,JYR,JDAY,ISCALE,INSS)
      PRINT 210,IT,IDENTT,NAME,JYR,JDAY,IDAY,L,QDAY,(MNVAL(I),SV(I),
     1I=1,3),IFIL
      CALL PLOTCV(ISCALE,INDSW)
      PRINT 210,IT,IDENTT,NAME,JYR,JDAY,IDAY,L,QDAY,(MNVAL(I),SV(I),
     1I=1,3),IFIL
      IF(IFIL.EQ.0)GO TO 2
C    FILTERS DATA
      DO 86 I=1,3
      DO 85 J=1,L
      DAT(J)=IDAT(J,I)-MNVAL(I)
   85 IF(IDAT(J,I).GT.90000)DAT(J)=0.0
      CALL FILTL(DAT,L,FI)
      CALL REVERS(DAT,S,L,G)
      CALL FILTL(DAT,L,FI)
      CALL REVERS(DAT,S,L,G)
```

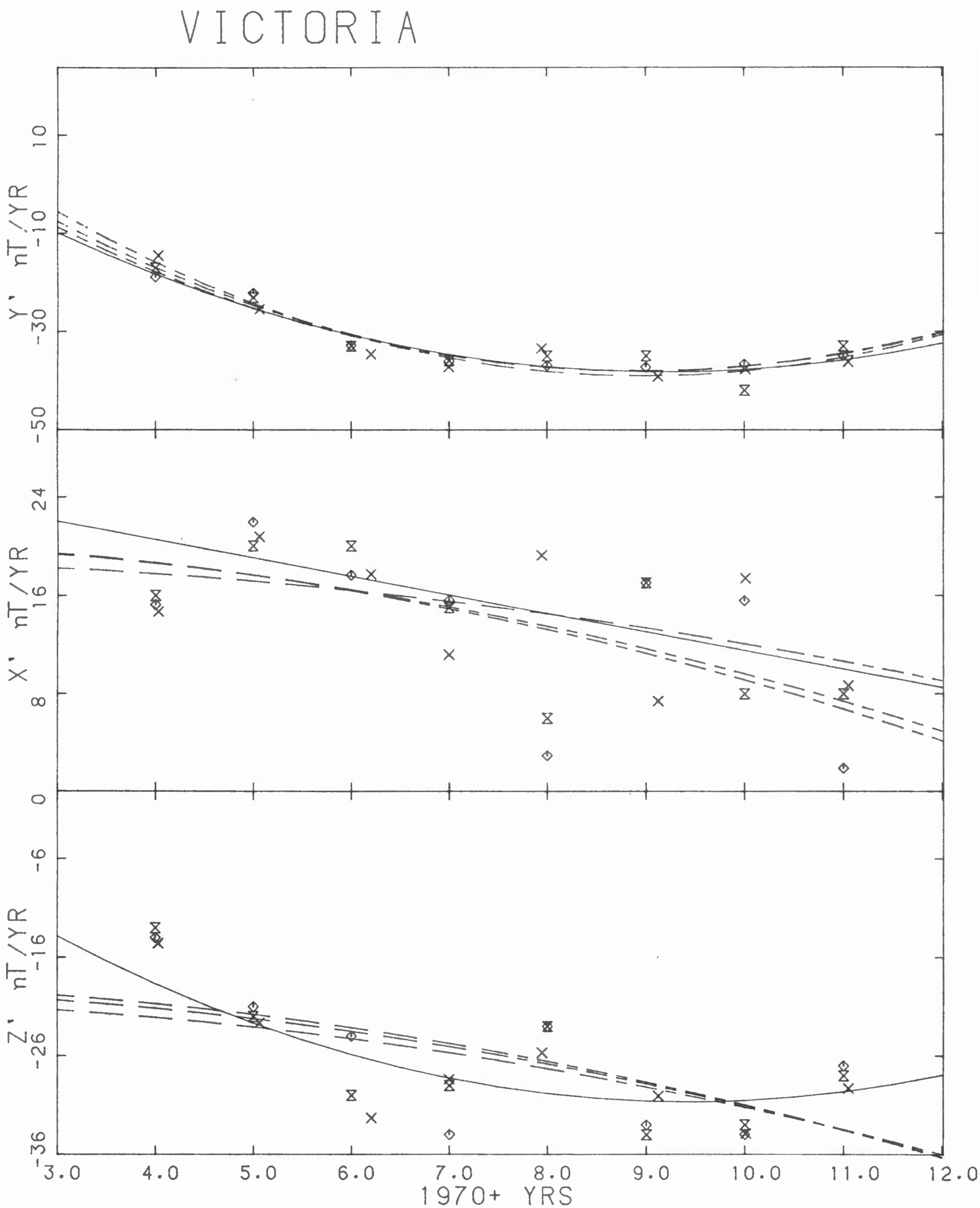
```
      DO 86 J=1,L
   86 IDAT(J,I)=DAT(J)+MNVAL(I)
      INDSW=0
      CALL PLOTLB(NAME,JYR,JDAY,ISCALE,INSS)
      PRINT 210,IT,IDENTT,NAME,JYR,JDAY,IDAY,L,ODAY,(MNVAL(I),SV(I),
     1I=1,3),IFIL
      CALL PLOTCV(ISCALE,INDSW)
      PRINT 210,IT,IDENTT,NAME,JYR,JDAY,IDAY,L,ODAY,(MNVAL(I),SV(I),
     1I=1,3),IFIL
      GO TO 2
   99 CALL PLOT(0.0,0.0,999)
      END
```

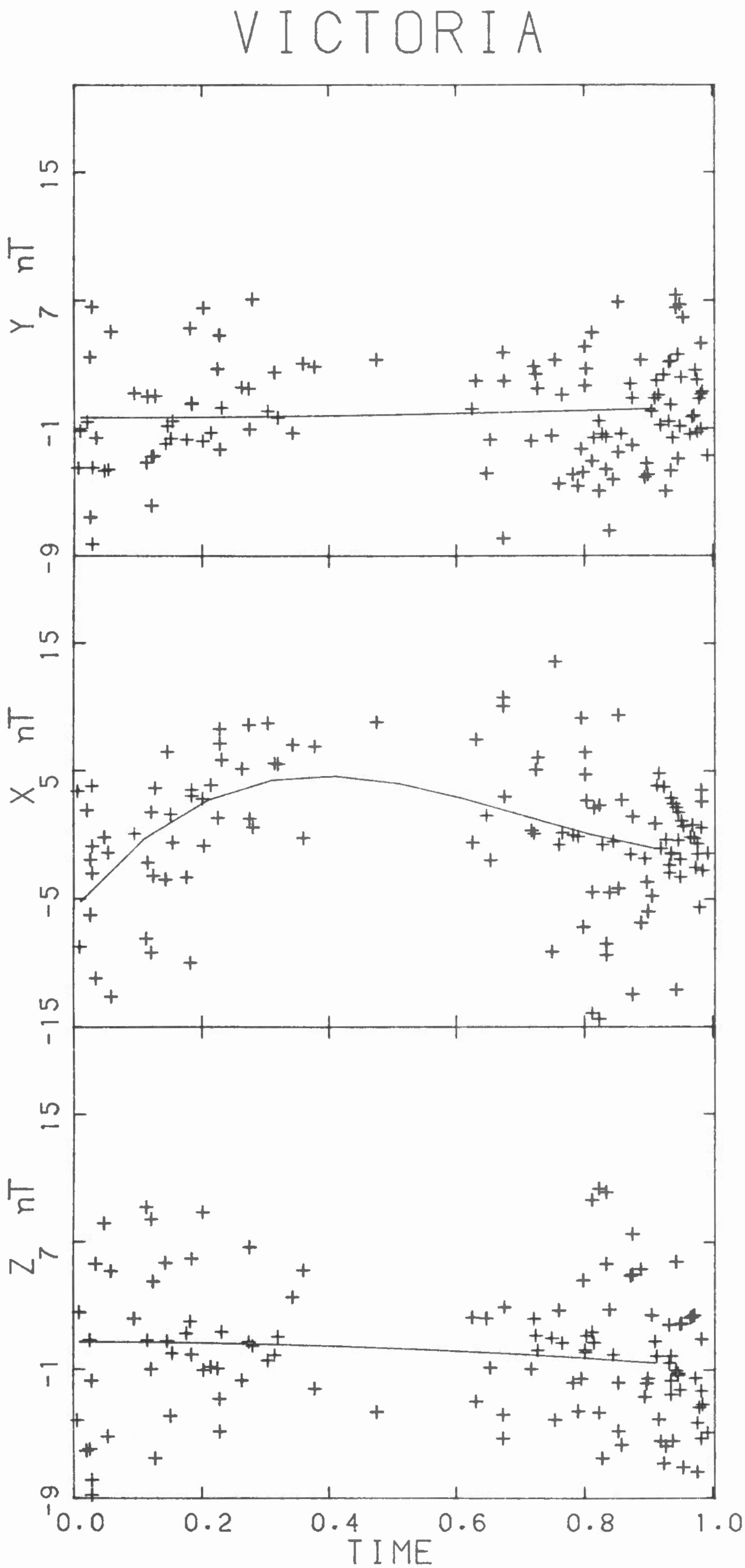
```
      SUBROUTINE CLDATE (DAY,YR,MNTH,DATE)
C
C     .......THIS SUBROUTINE DETERMINES THE DATE OF A GIVEN SEQUENTIAL
C     ......DAY OF AN YEAR
C     ......DAY,YR,AND DATE MUST BE DECLARED INTEGERS IN THE MAIN PROGRA
C     ......DAY IS THE SEQUENTIAL DAY OF THE YEAR YR --BOTH  INPUT
C     ......TO THE SUBROUTINE
C     ......MNTH IS THE OUTPUT MONTH IN ALPHA
C     ......DATE IS THE OUTPUT DATE IN NUMERIC
C
      INTEGER DATE,DAY,YR
      DIMENSION IA(12), MOTH(12)
      DATA MOTH/5HJAN. ,5HFEB. ,5HMAR. ,5HAPR. ,5HMAY  ,5HJUNE ,5HJULY ,
     15HAUG. ,5HSEPT.,5HOCT. ,5HNOV. ,5HDEC. /
      DATA IA/31,28,31,30,31,30,31,31,30,31,30,31/
      INDLP=0
C
C     ......LEAP YEAR TEST
C
      LT=YR-100*(YR/100)
      IF (LT) 10,10,20
10    LT=YR-400*(YR/400)
      IF (LT) 40,30,40
20    LT=YR-4*(YR/4)
      IF (LT) 40,30,40
30    INDLP=1
40    IF (INDLP-1) 60,50,60
50    IA(2)=29
      GO TO 70
60    IA(2)=28
70    ICOL=0
      DO 80 I=1,12
      ICOL=ICOL+IA(I)
      IF (ICOL.GE.DAY) GO TO 90
80    CONTINUE
90    DATE=DAY-(ICOL-IA(I))
      MNTH=MOTH(I)
      RETURN
      END
```

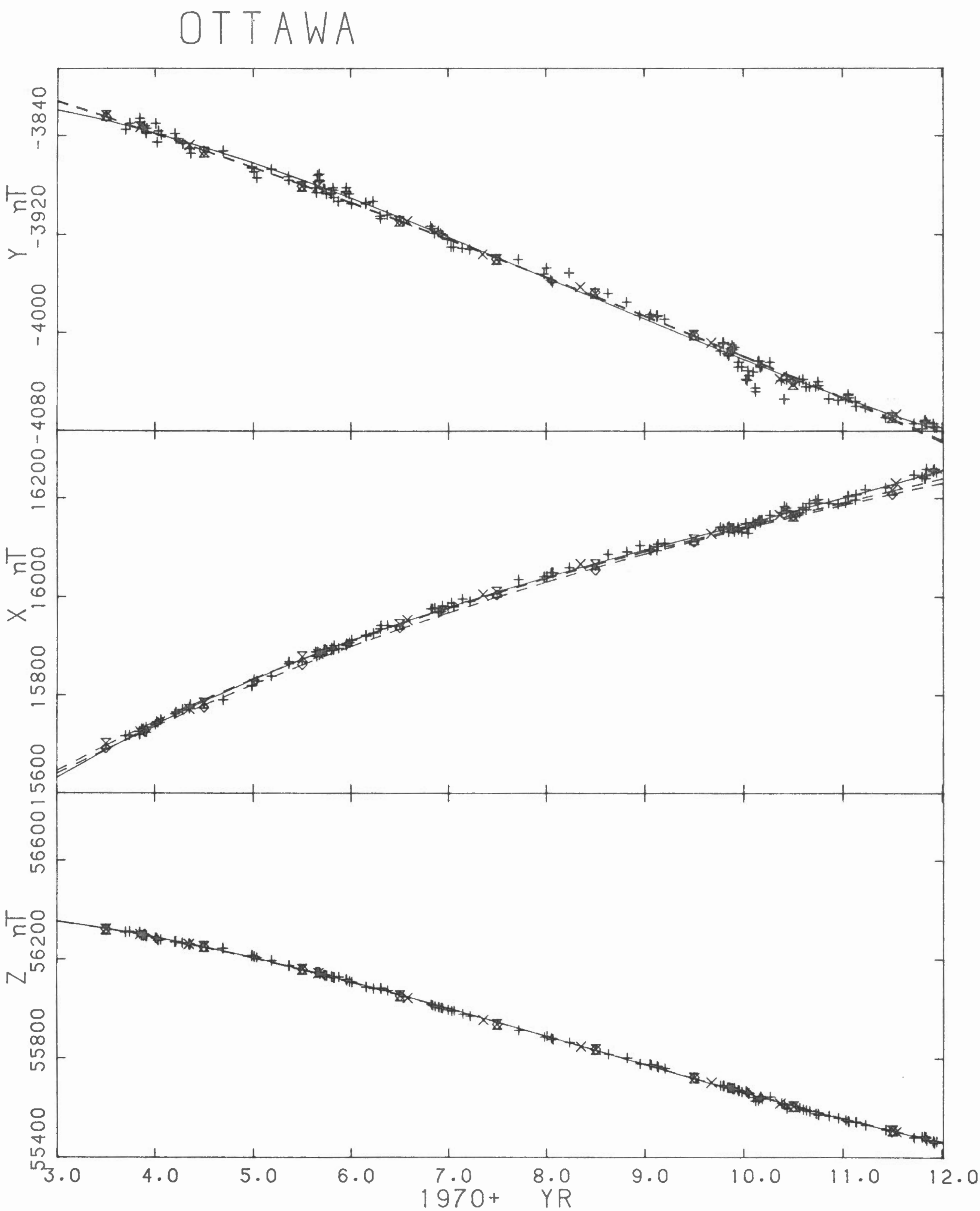
APPENDIX E: Observatory Plots

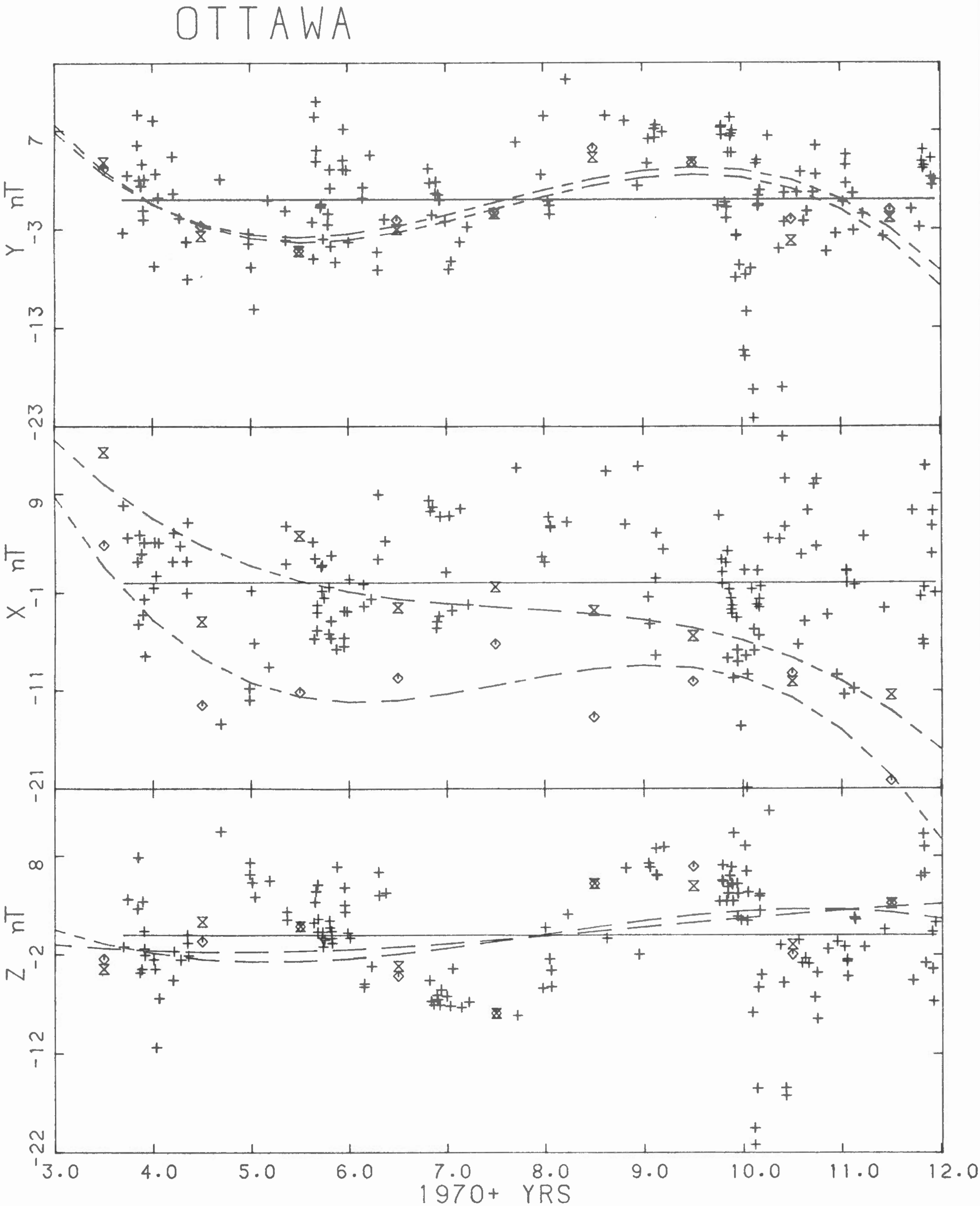

VICTORIA
Y nT
7160
7080
7000
6920
X nT
17720
17670
17620
17570
Z nT
53060
52980
52900
52820
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR


VICTORIA
Y nT
X nT
Z nT
5
0
-5
-10
9
-1
-11
-21
14
6
-2
-10
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

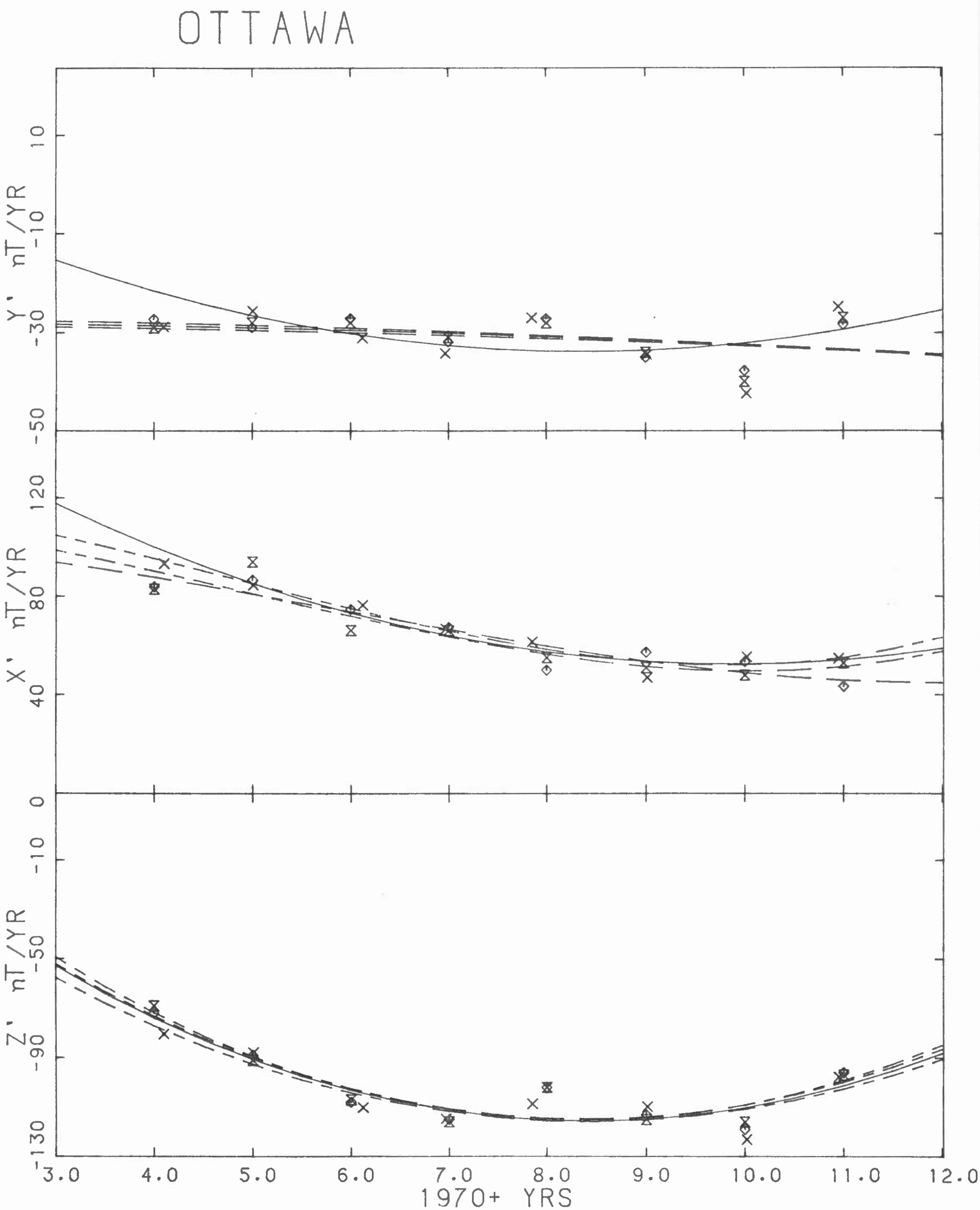

VICTORIA
Y' nT/YR
10
-10
-30
-50
X' nT/YR
24
16
8
0
Z' nT/YR
-6
-16
-26
-36
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

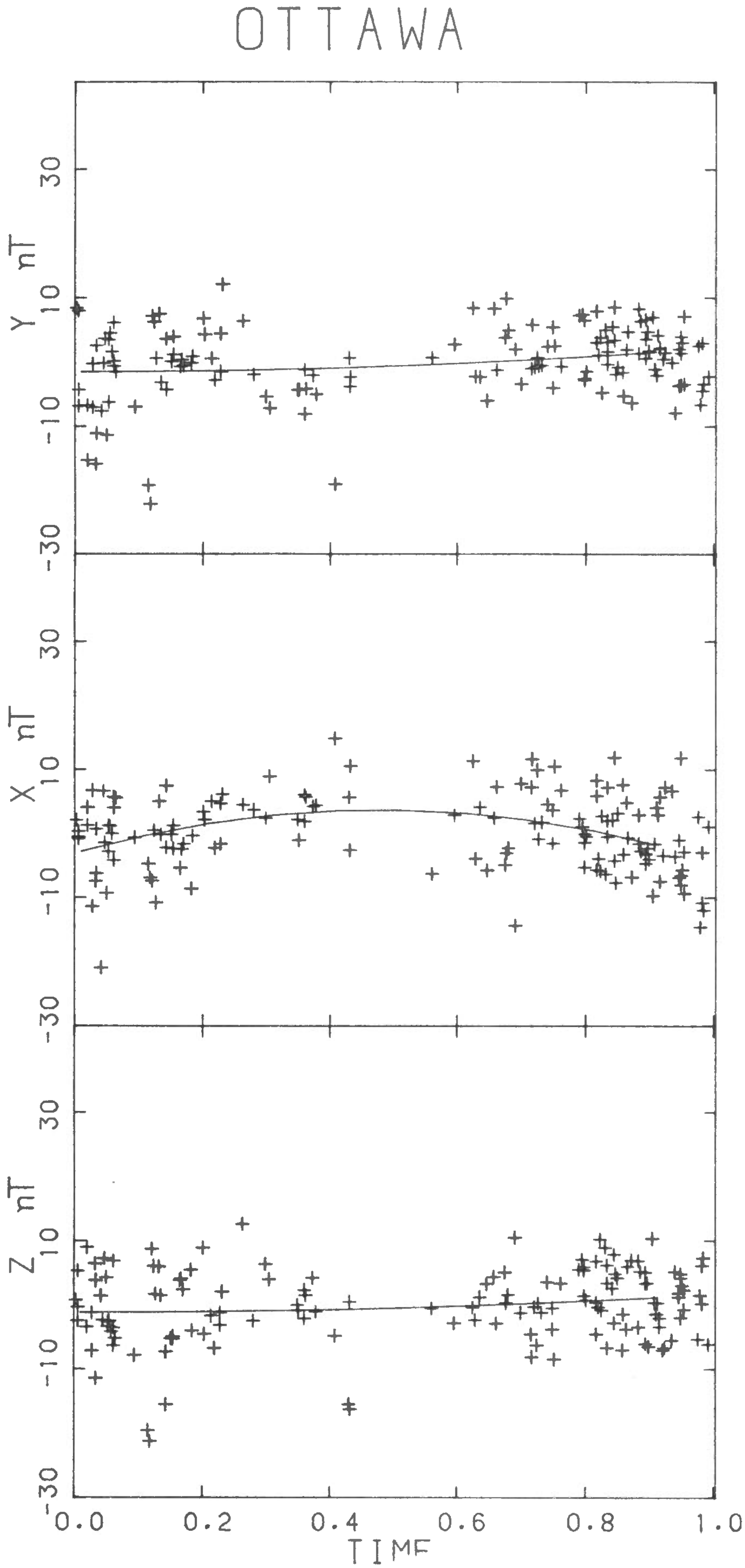

VICTORIA
Y nT
15
7
-1
-9
X nT
15
5
-5
-15
Z nT
15
7
-1
-9
0.0
0.2
0.4
0.6
0.8
1.0
TIME

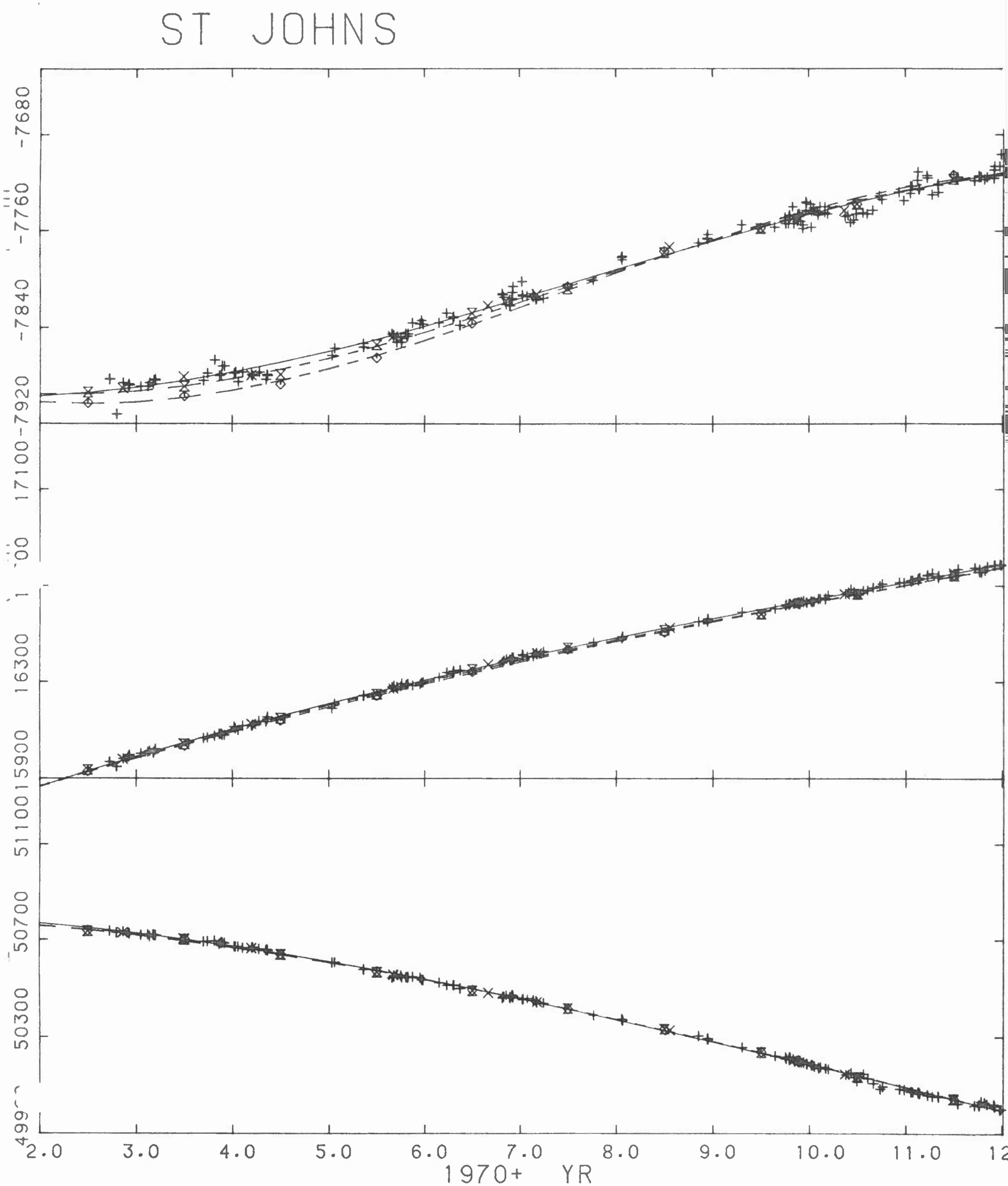

OTTAWA
Y nT
-3840
-3920
-4000
-4080
X nT
16200
16000
15800
15600
Z nT
56600
56200
55800
55400
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR

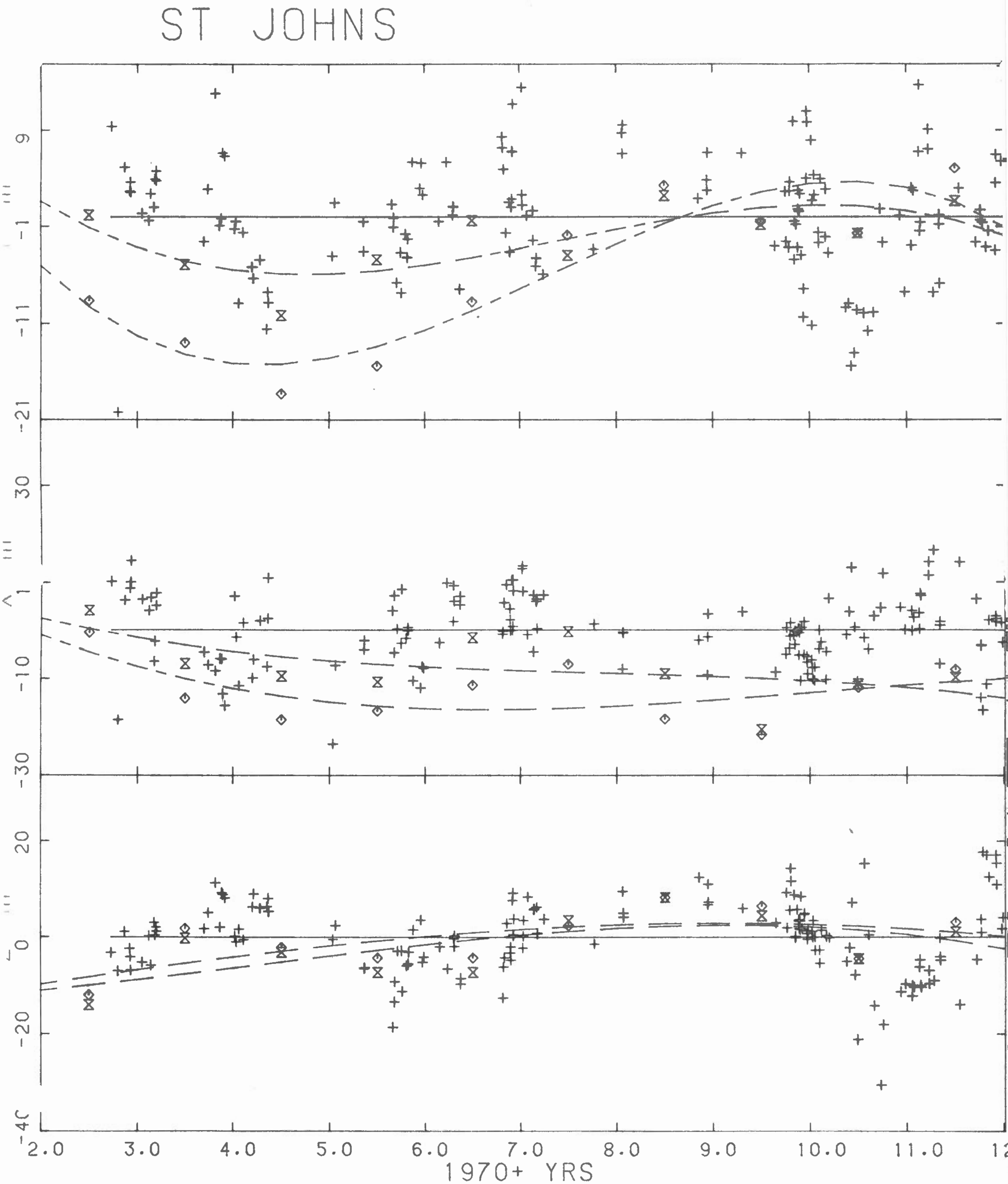


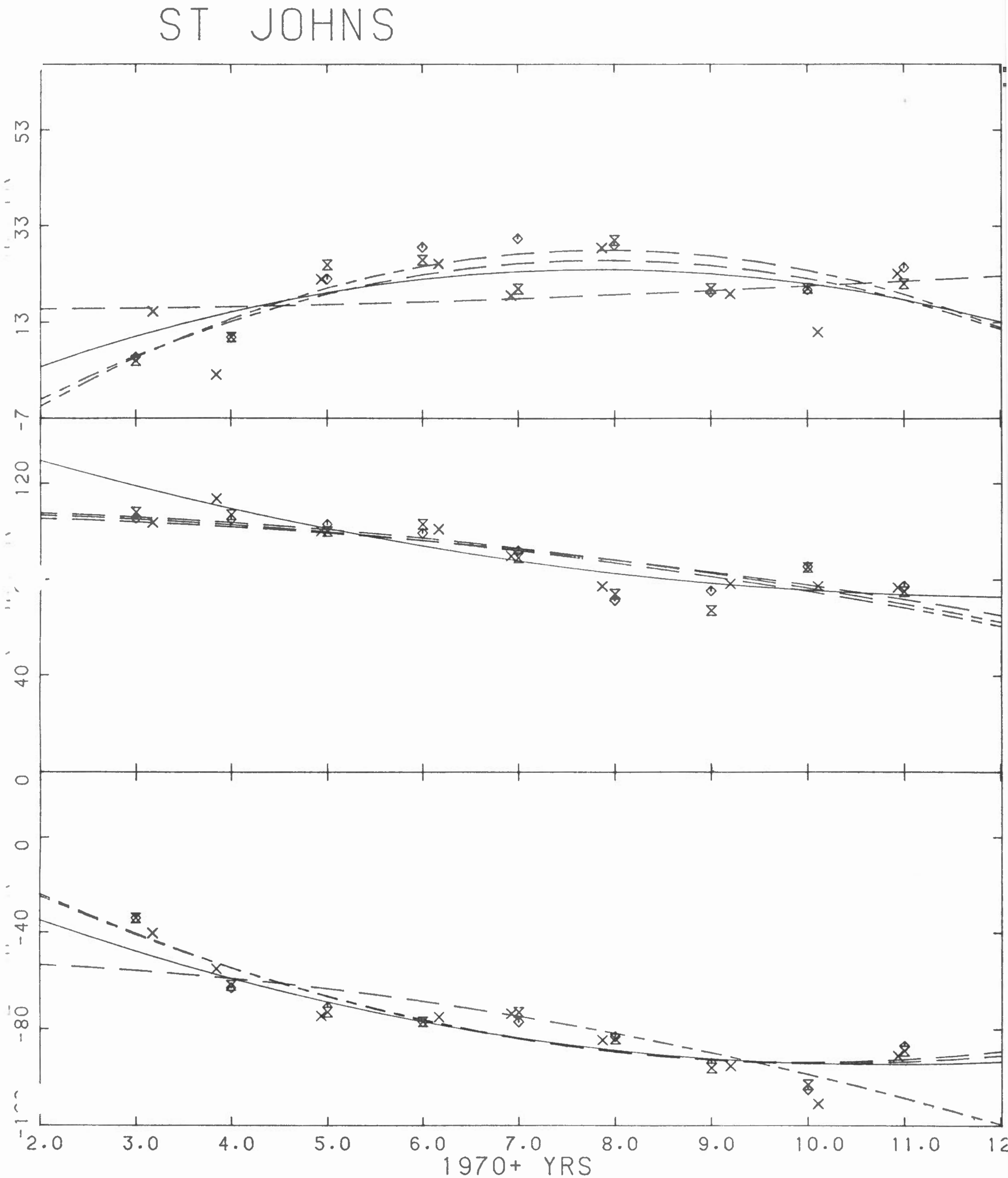
OTTAWA
Y nT
7
-3
-13
-23
X nT
9
-1
-11
-21
Z nT
8
-2
-12
-22
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

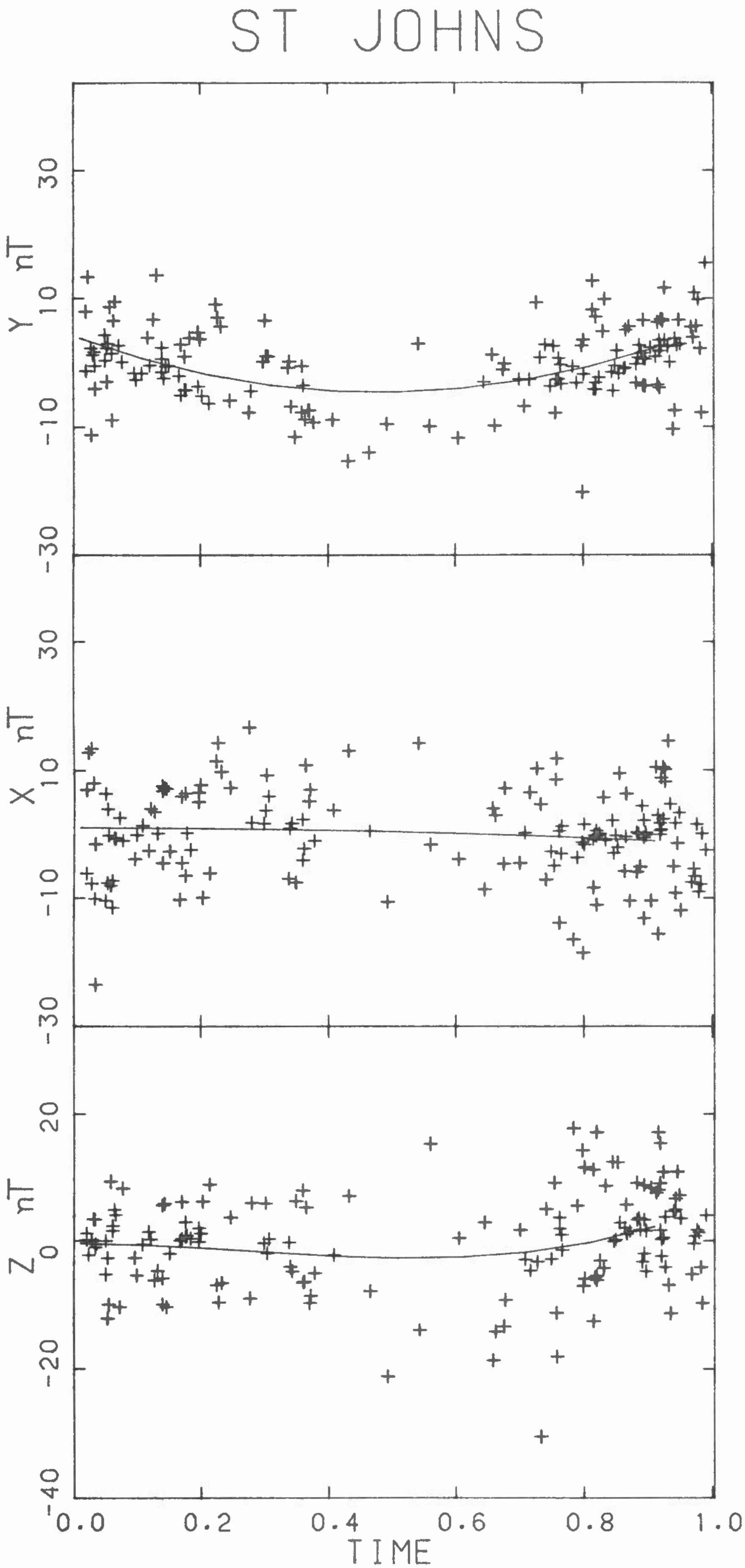

OTTAWA
Y' nT/YR
10
-10
-30
-50
X' nT/YR
120
80
40
0
Z' nT/YR
-10
-50
-90
-130
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

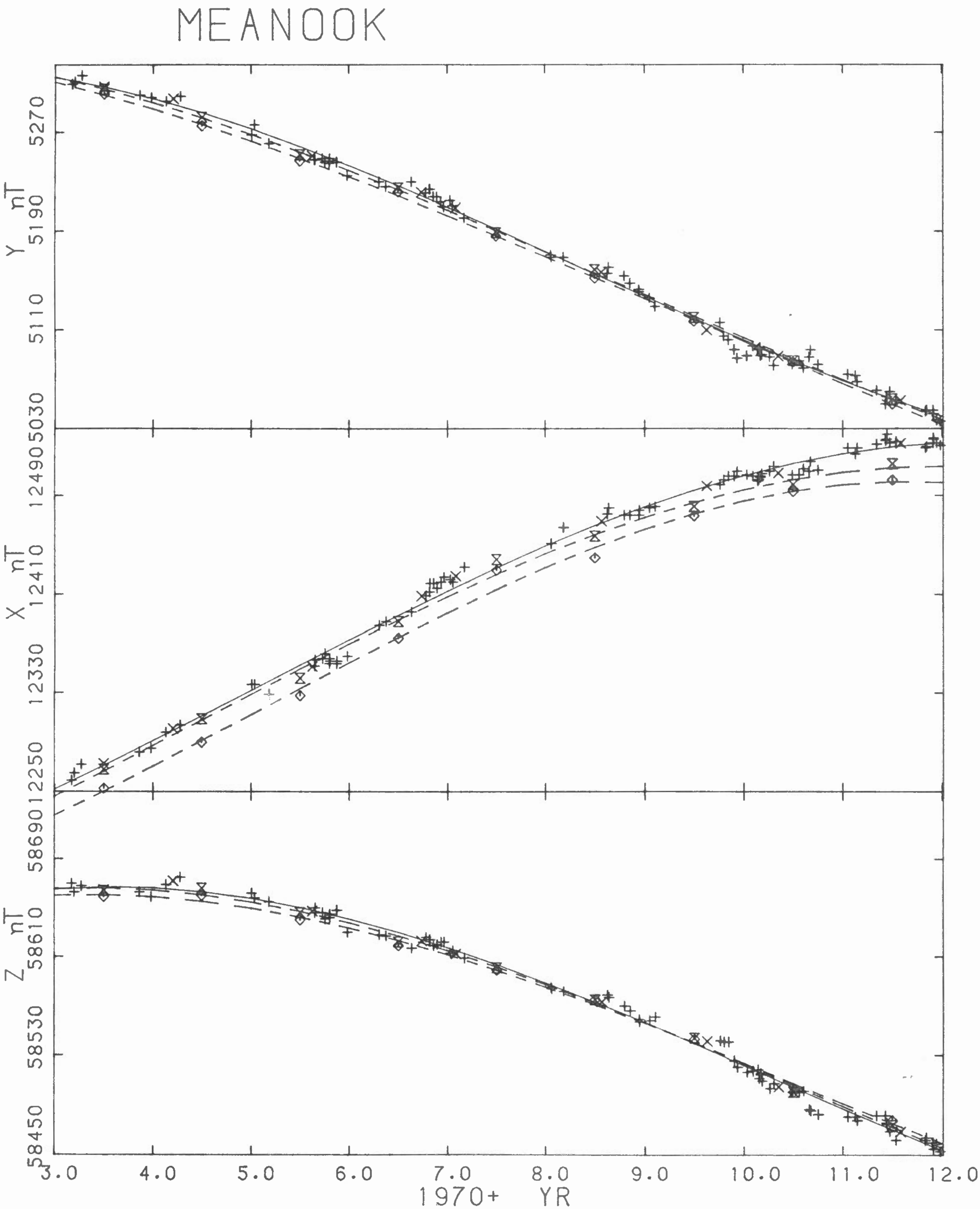

OTTAWA
Y nT
X nT
Z nT
30
10
-10
-30
0.0
0.2
0.4
0.6
0.8
1.0
TIME

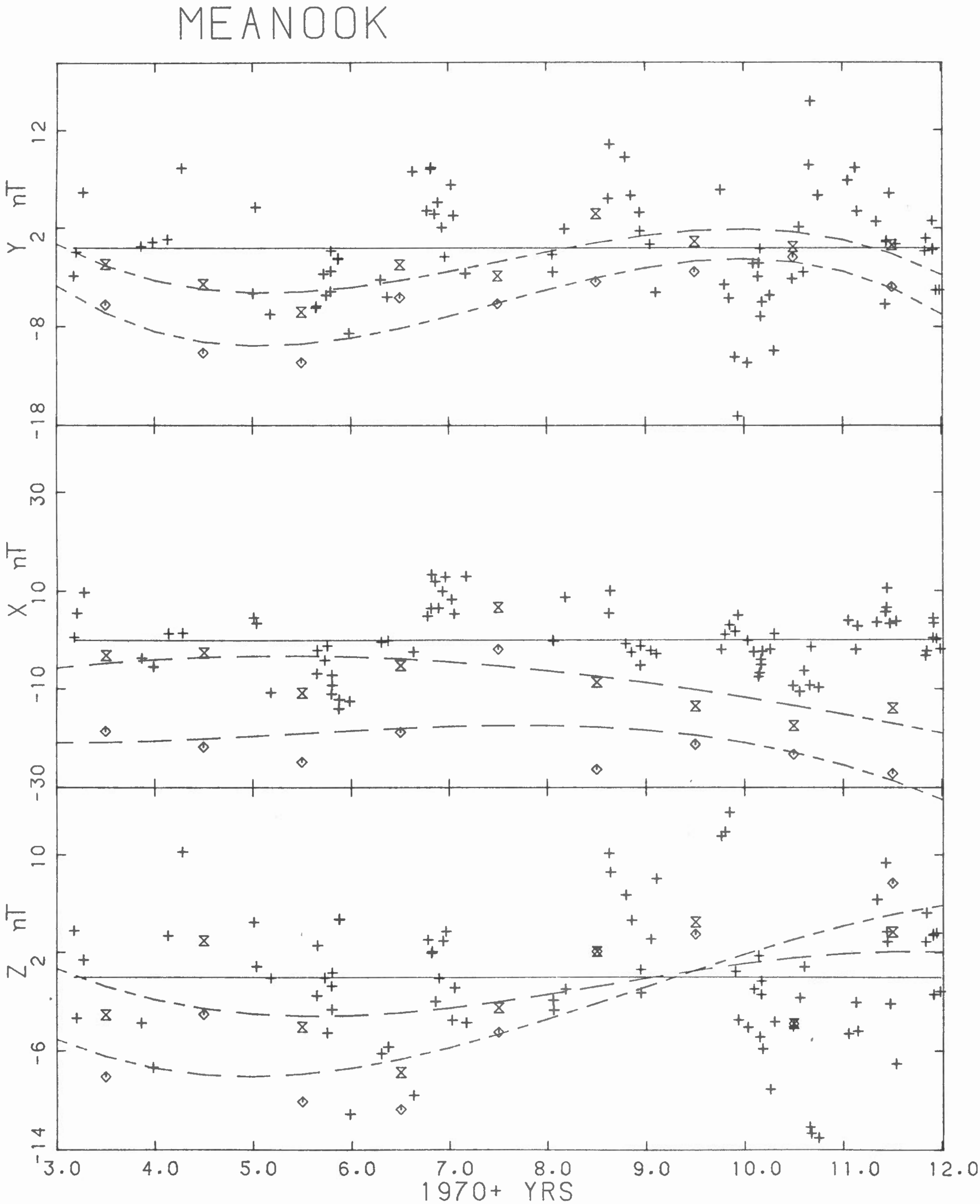

ST JOHNS
-7680
-7760
-7840
-7920
17100
16300
15900
51100
50700
50300
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
1970+ YR

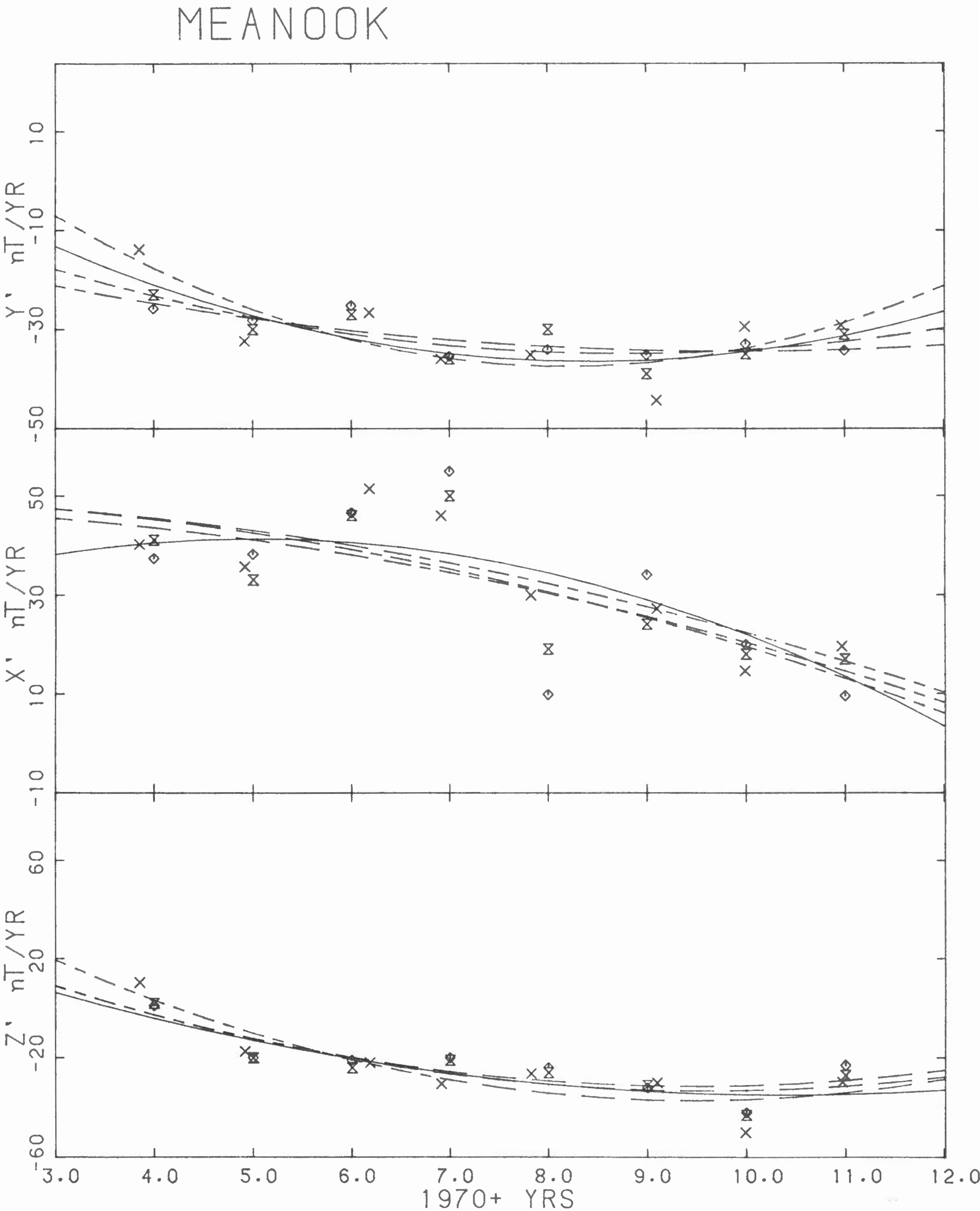

ST JOHNS
9
-1
-11
-21
30
-10
-30
20
0
-20
-40
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
1970+ YRS

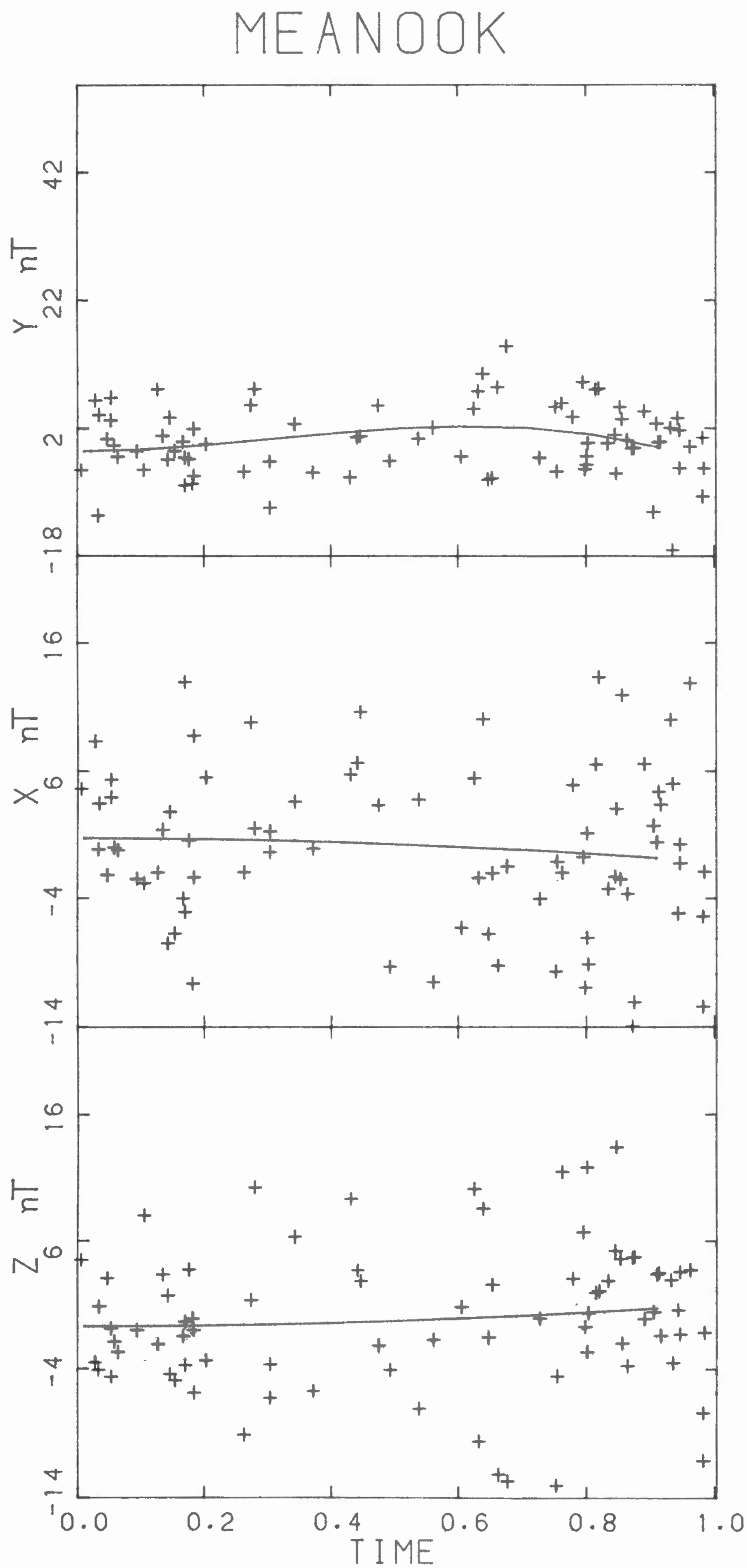

ST JOHNS
53
33
13
-7
120
40
0
0
-40
-80
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
1970+ YRS

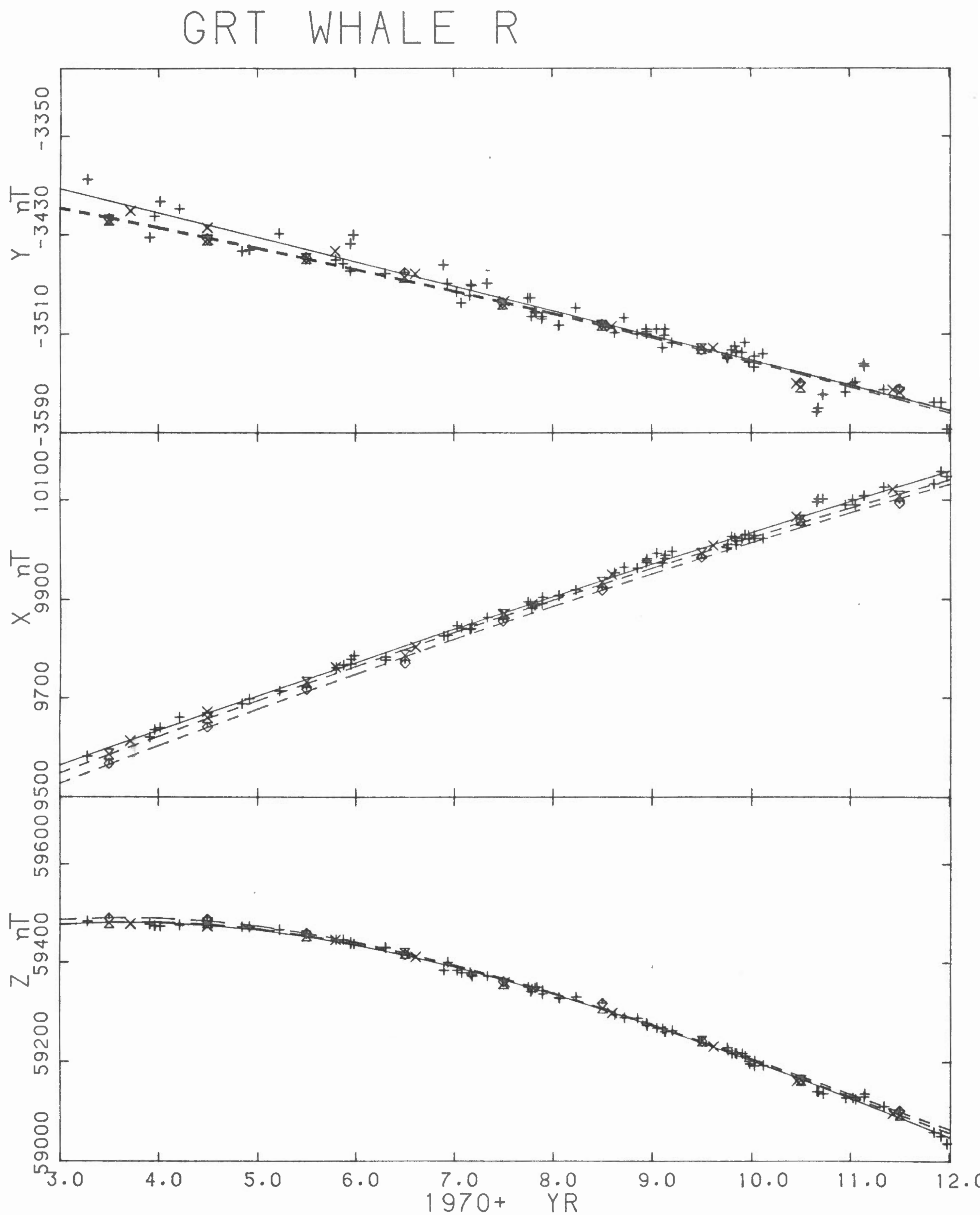

ST JOHNS
Y nT
30
10
-10
-30
X nT
30
10
-10
-30
Z nT
20
0
-20
-40
0.0
0.2
0.4
0.6
0.8
1.0
TIME

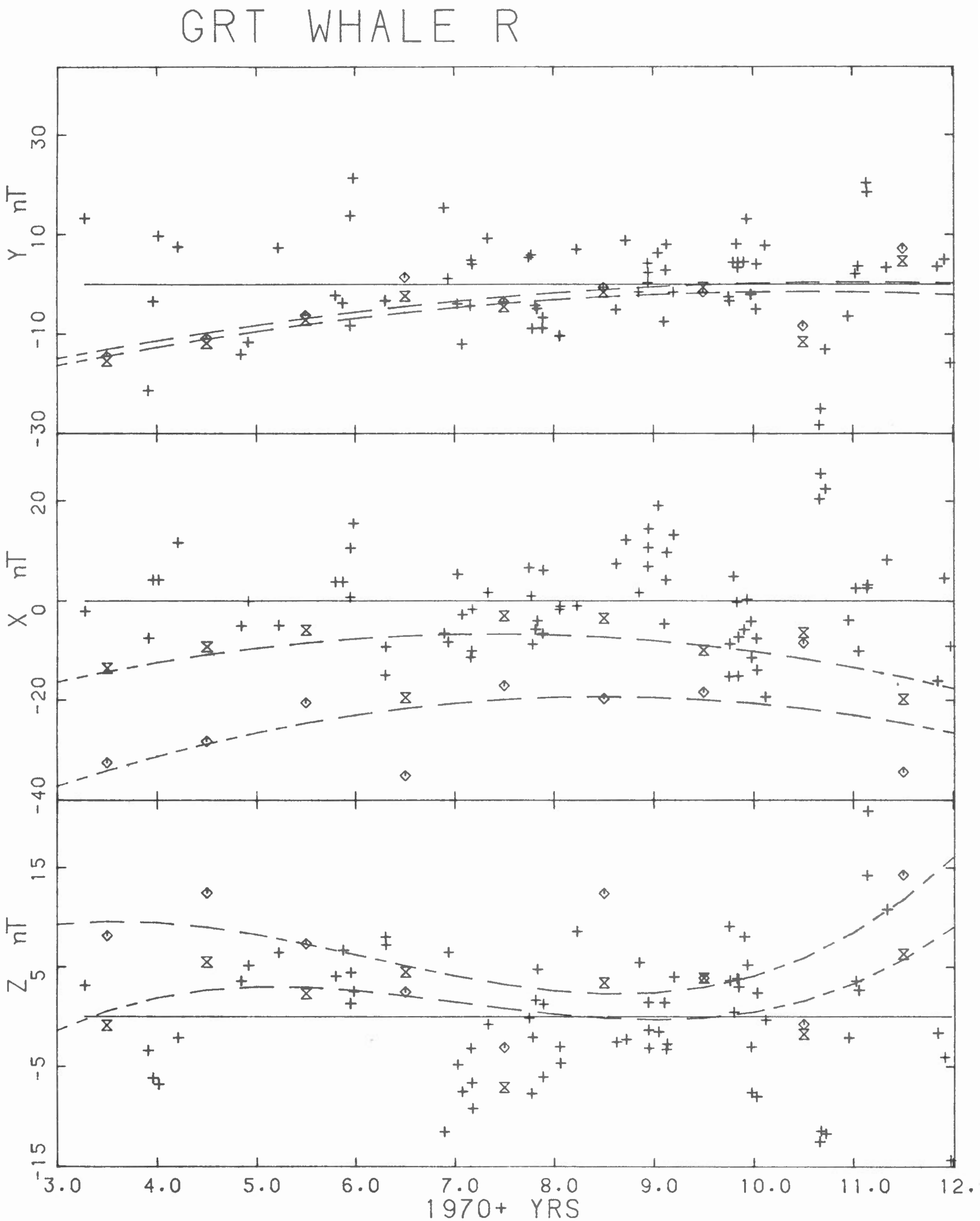

MEANOOK
Y nT
5270
5190
5110
5030
X nT
12490
12410
12330
12250
Z nT
58690
58610
58530
58450
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR

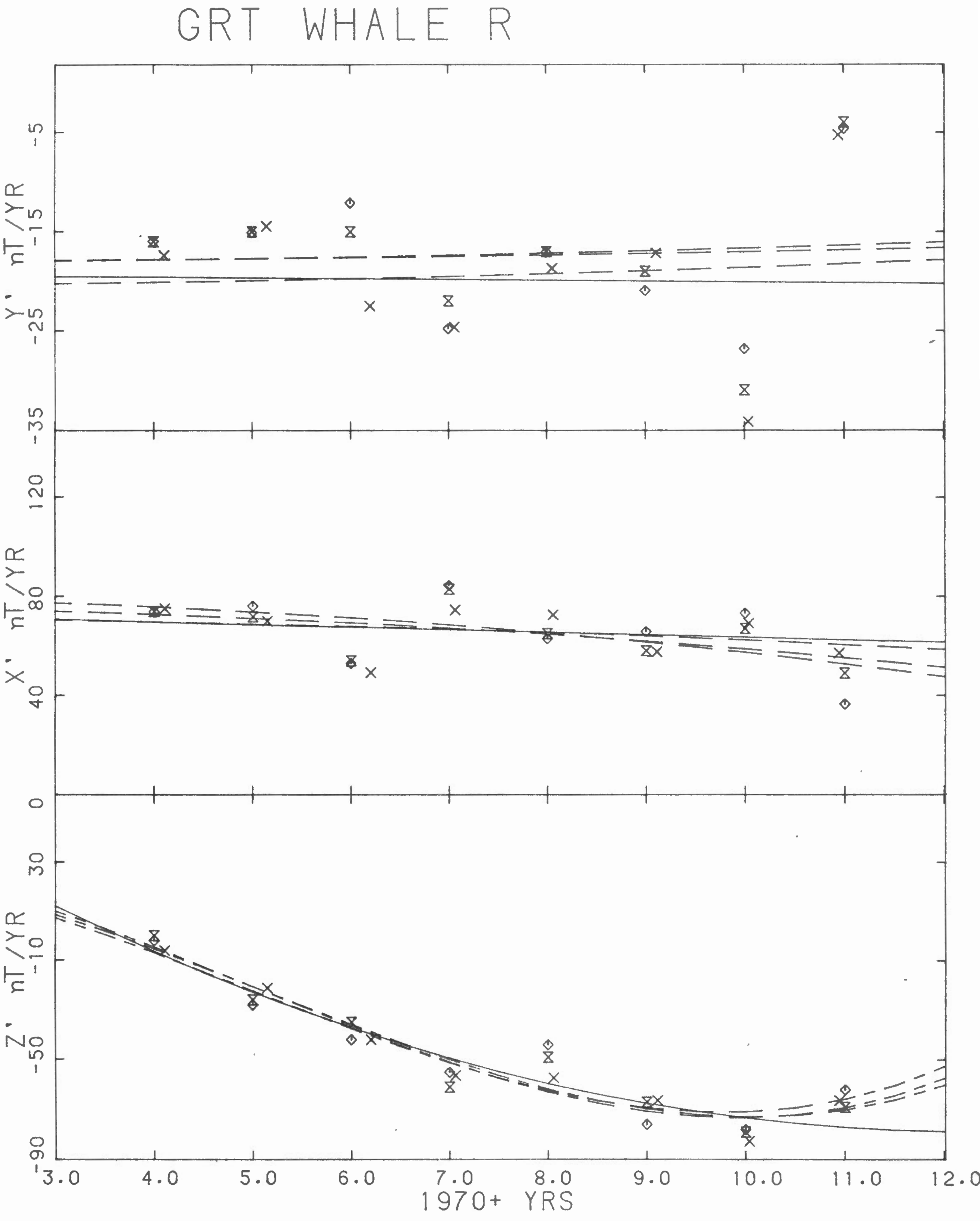

MEANOOK
Y nT
12
2
-8
-18
X nT
30
10
-10
-30
Z nT
10
2
-6
-14
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

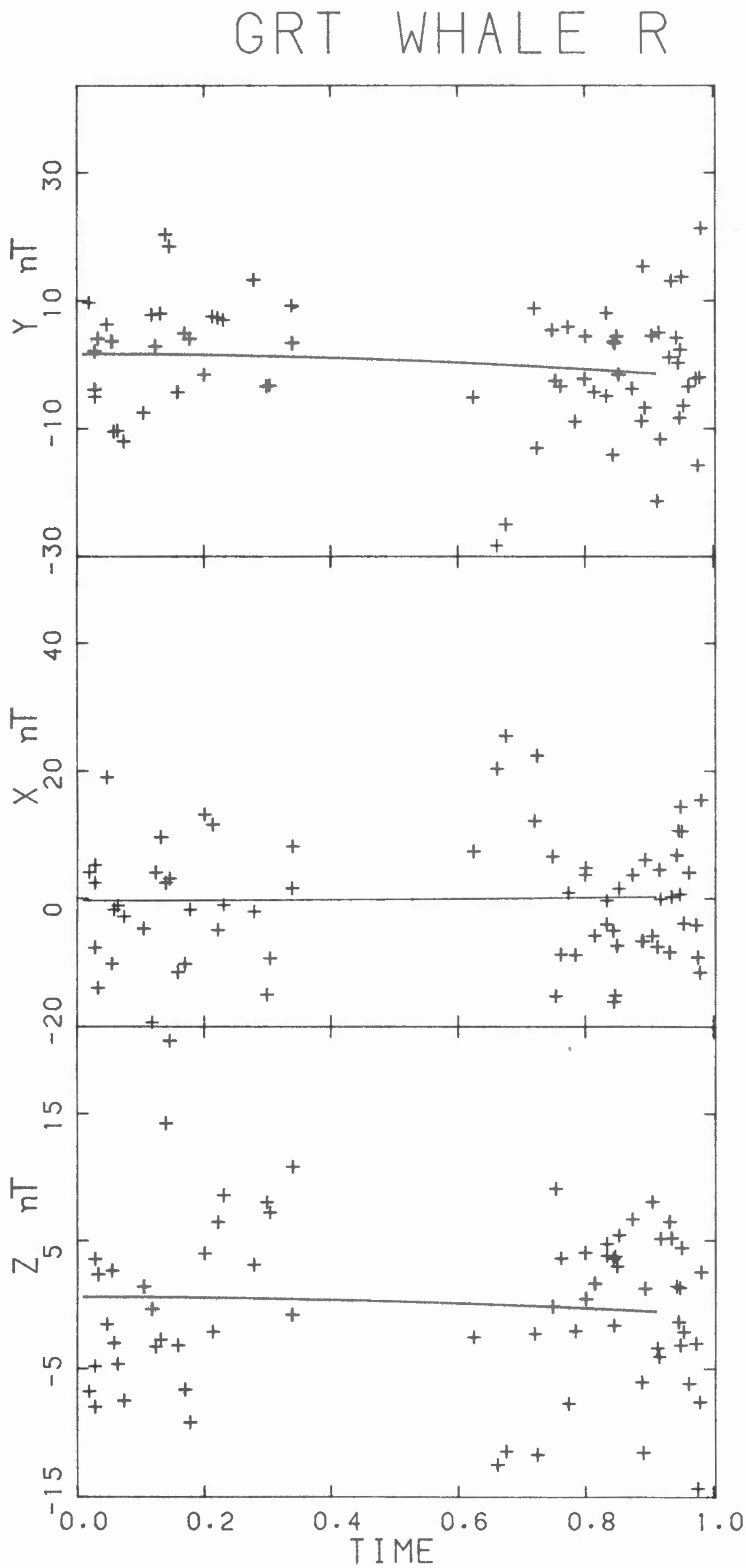

MEANOOK
Y' nT/YR
10
-10
-30
-50
X' nT/YR
50
30
10
-10
Z' nT/YR
60
20
-20
-60
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

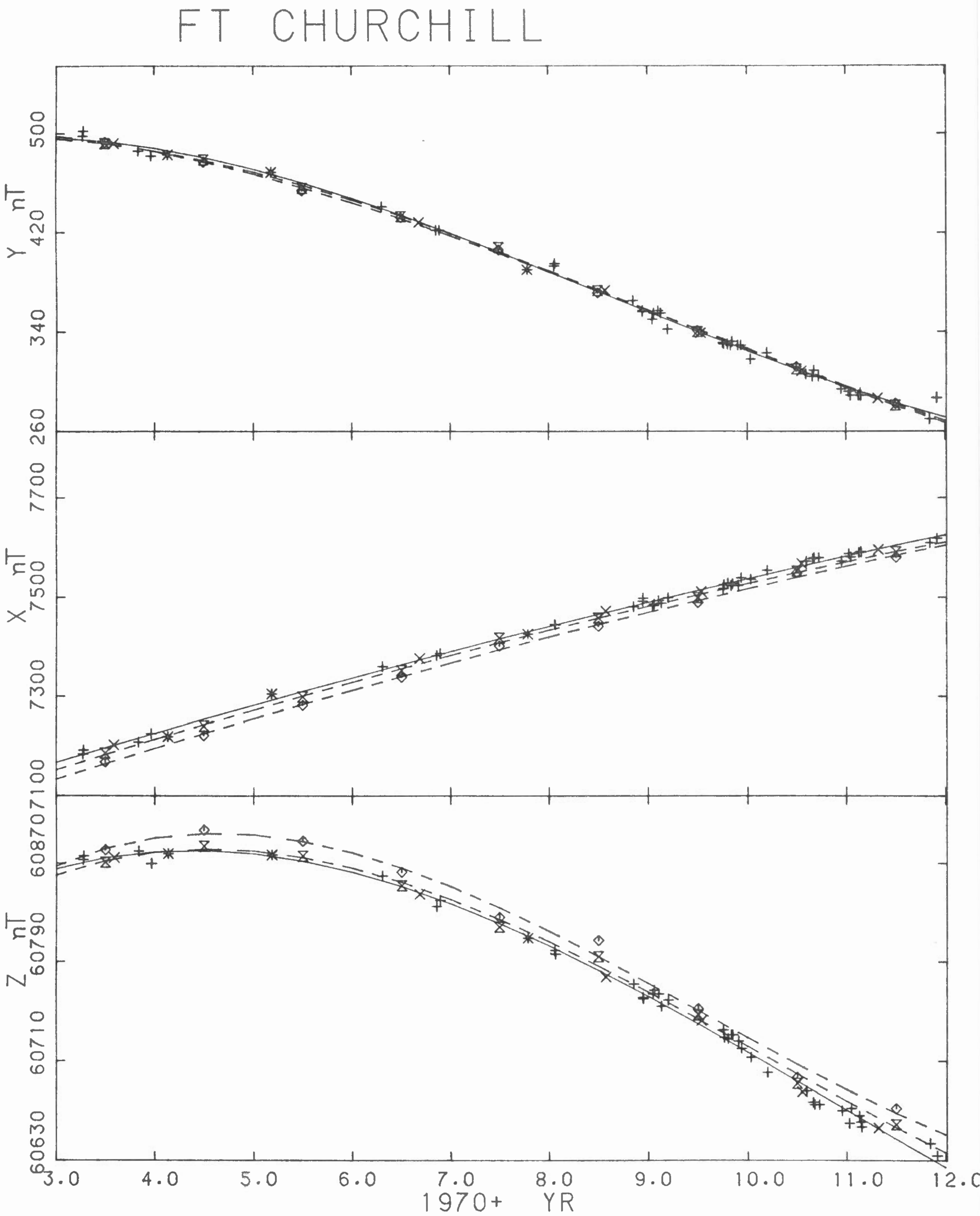

MEANOOK
Y nT
42
22
2
-18
X nT
16
6
-4
-14
Z nT
16
6
-4
-14
0.0
0.2
0.4
0.6
0.8
1.0
TIME

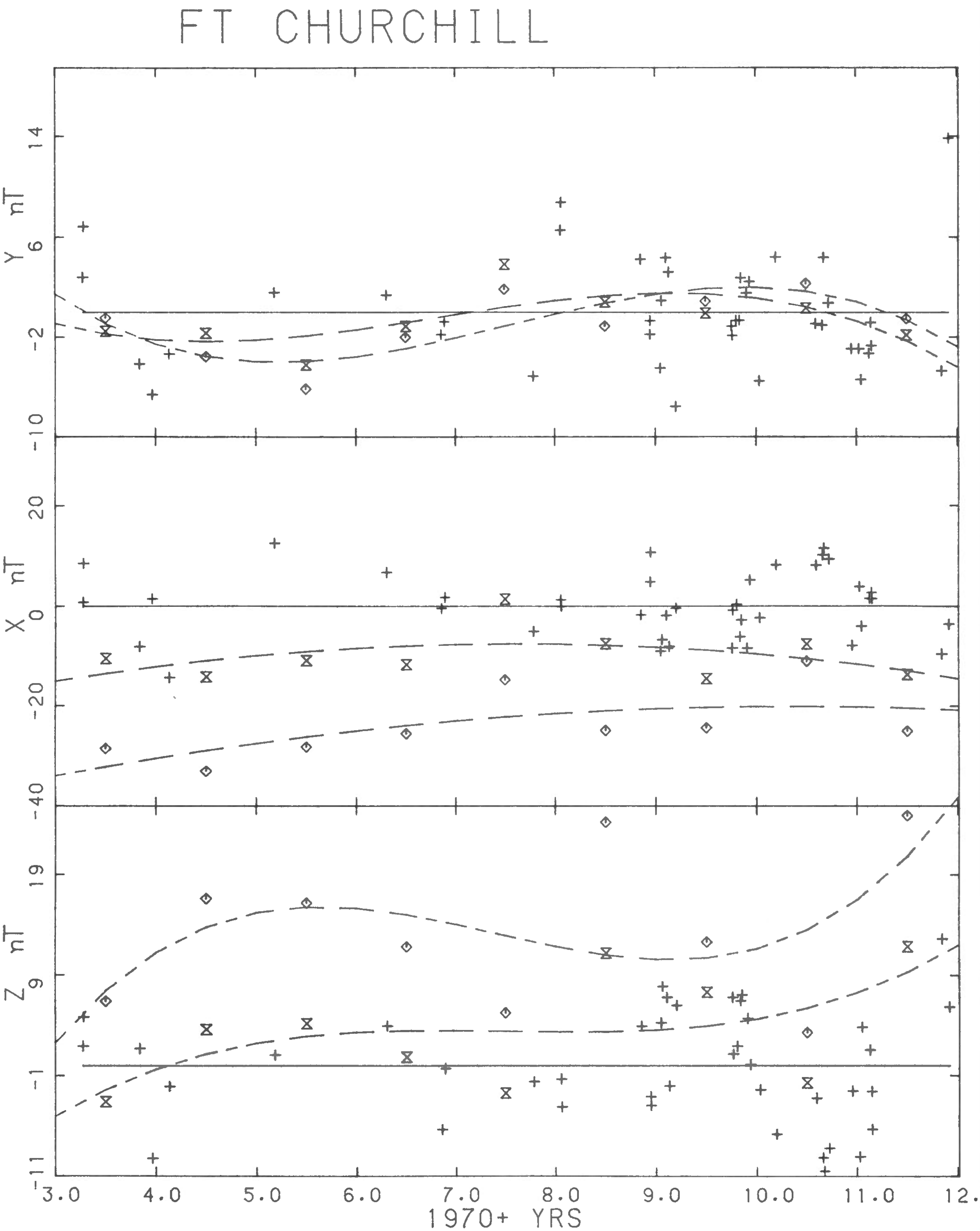

GRT WHALE R
Y nT
-3350
-3430
-3510
-3590
X nT
9500
9700
9900
10100
Z nT
59000
59200
59400
59600
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR

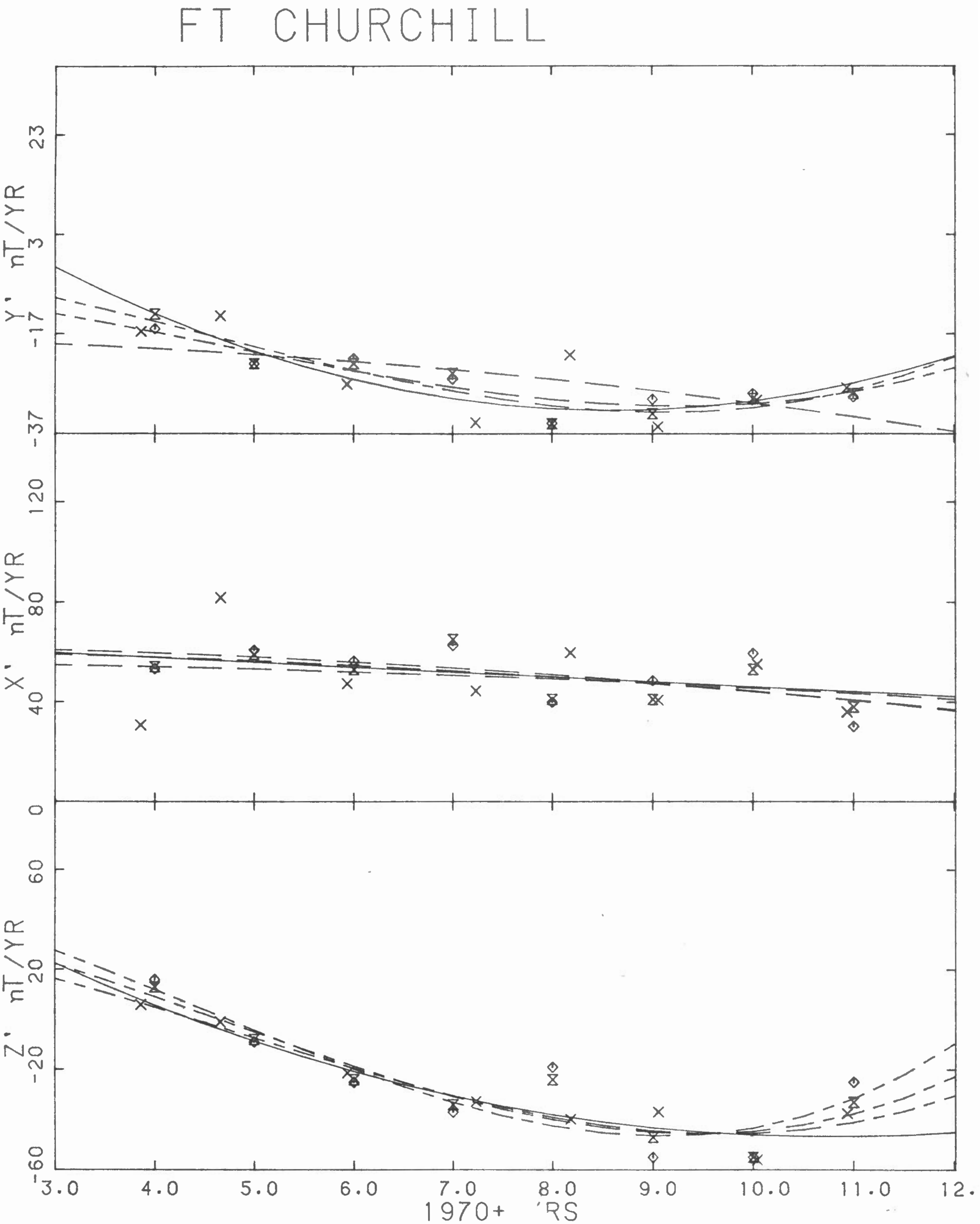

GRT WHALE R
Y nT
30
10
-10
-30
X nT
20
0
-20
-40
Z nT
15
5
-5
-15
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.
1970+ YRS


GRT WHALE R
Y' nT/YR
-5
-15
-25
-35
X' nT/YR
120
80
40
0
Z' nT/YR
30
-10
-50
-90
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

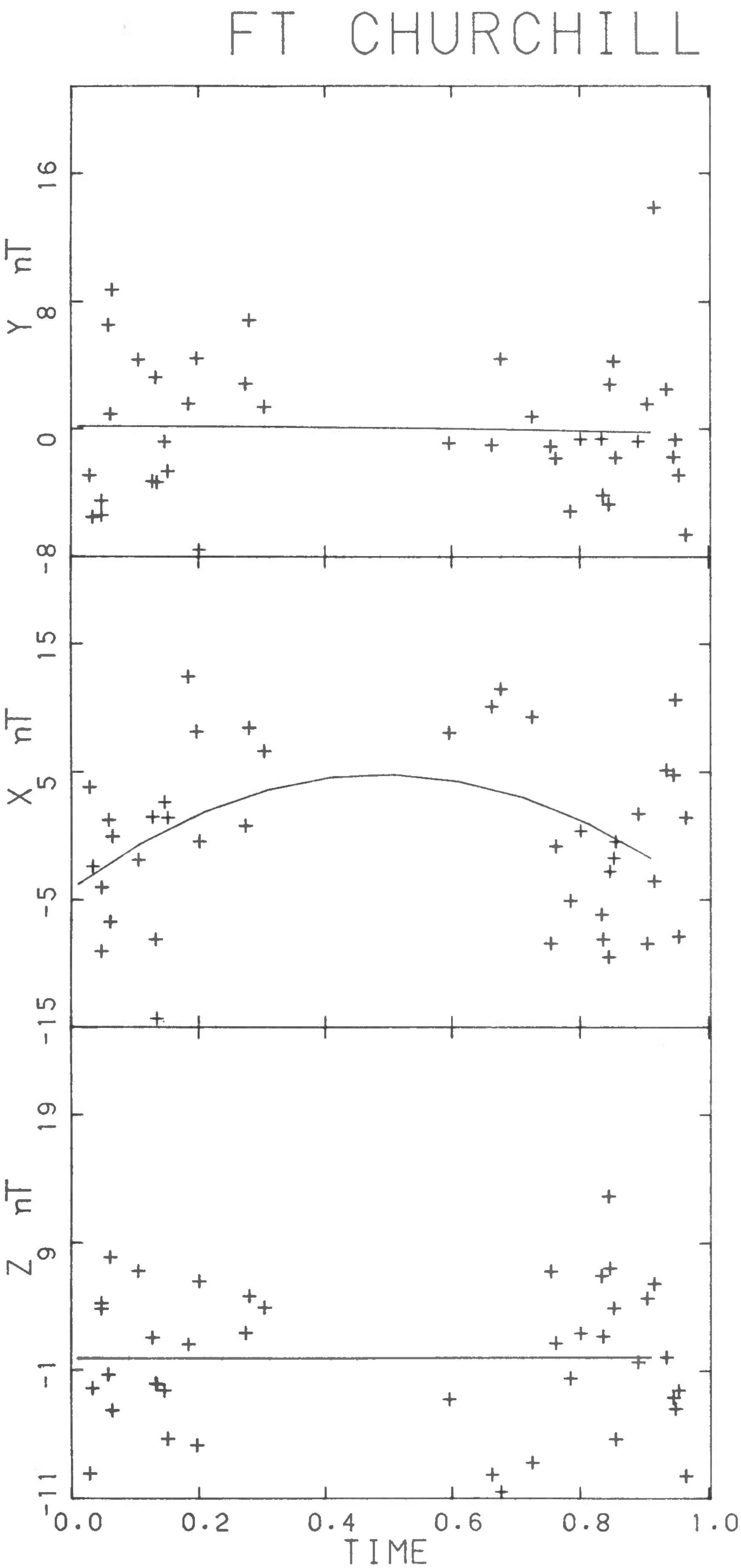

GRT WHALE R
Y nT
30
10
-10
-30
X nT
40
20
0
-20
Z nT
15
5
-5
-15
0.0
0.2
0.4
0.6
0.8
1.0
TIME

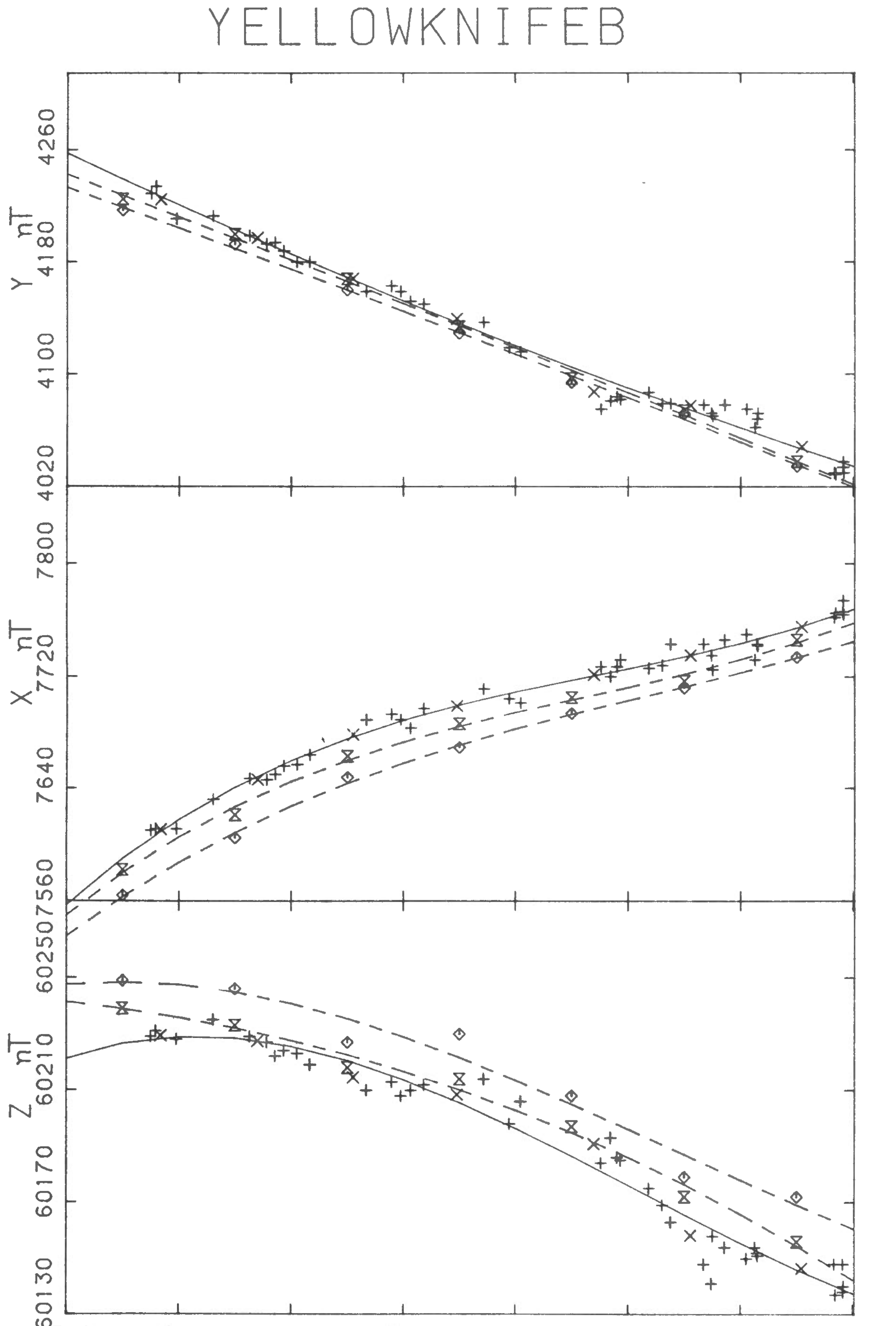

FT CHURCHILL
Y nT
500
420
340
260
X nT
7700
7500
7300
7100
Z nT
60870
60790
60710
60630
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR


FT CHURCHILL
Y nT
14
6
-2
-10
X nT
20
0
-20
-40
Z nT
19
9
-1
-11
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.
1970+ YRS

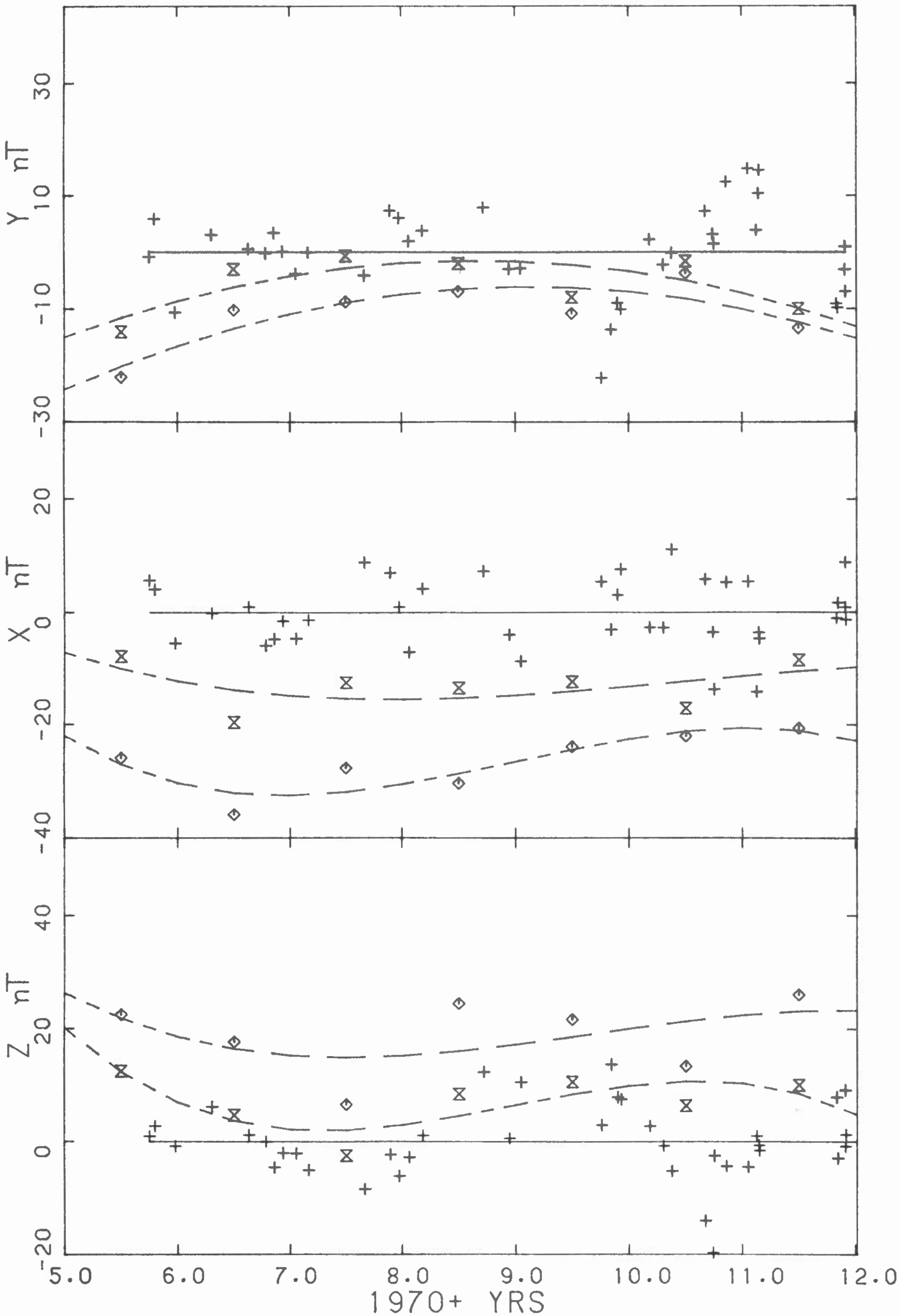


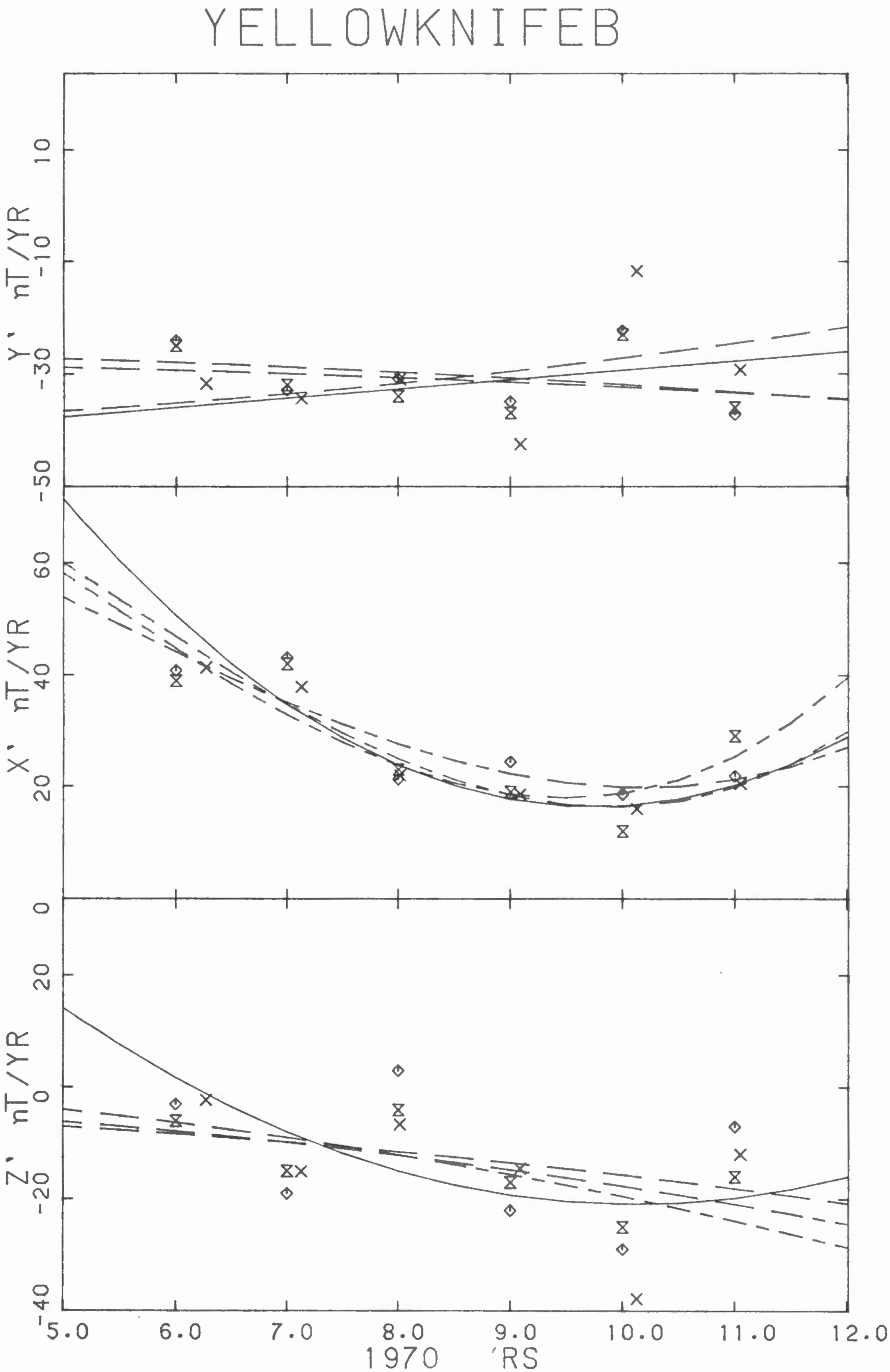
FT CHURCHILL
Y' nT/YR
23
3
-17
-37
X' nT/YR
120
80
40
0
Z' nT/YR
60
20
-20
-60
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.
1970+ 'RS

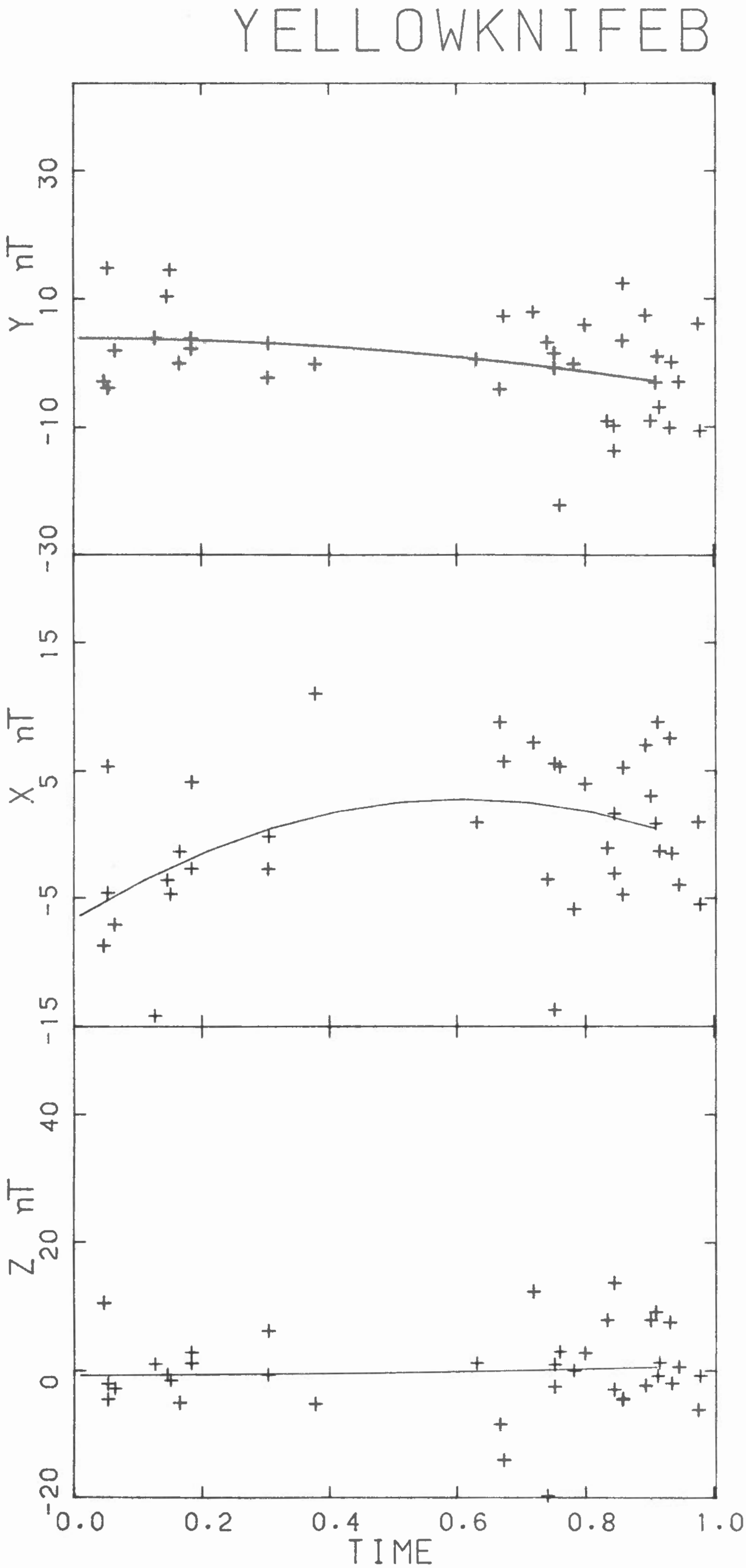

FT CHURCHILL
Y nT
16
8
0
-8
X nT
15
5
-5
-15
Z nT
19
9
-1
-11
0.0
0.2
0.4
0.6
0.8
1.0
TIME

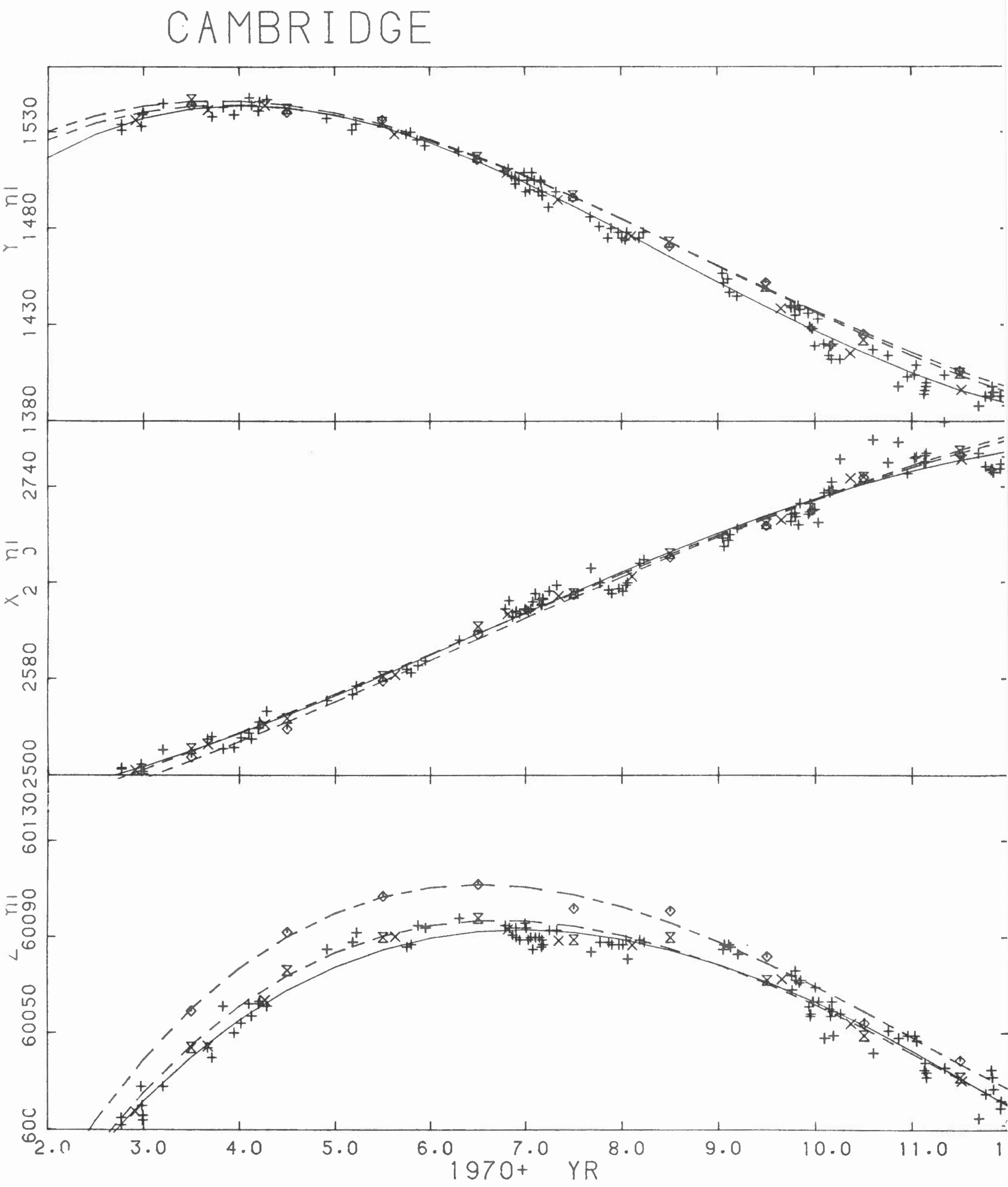

YELLOWKNIFEB
Y nT
4260
4180
4100
4020
X nT
7800
7720
7640
7560
Z nT
60250
60210
60170
60130
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR

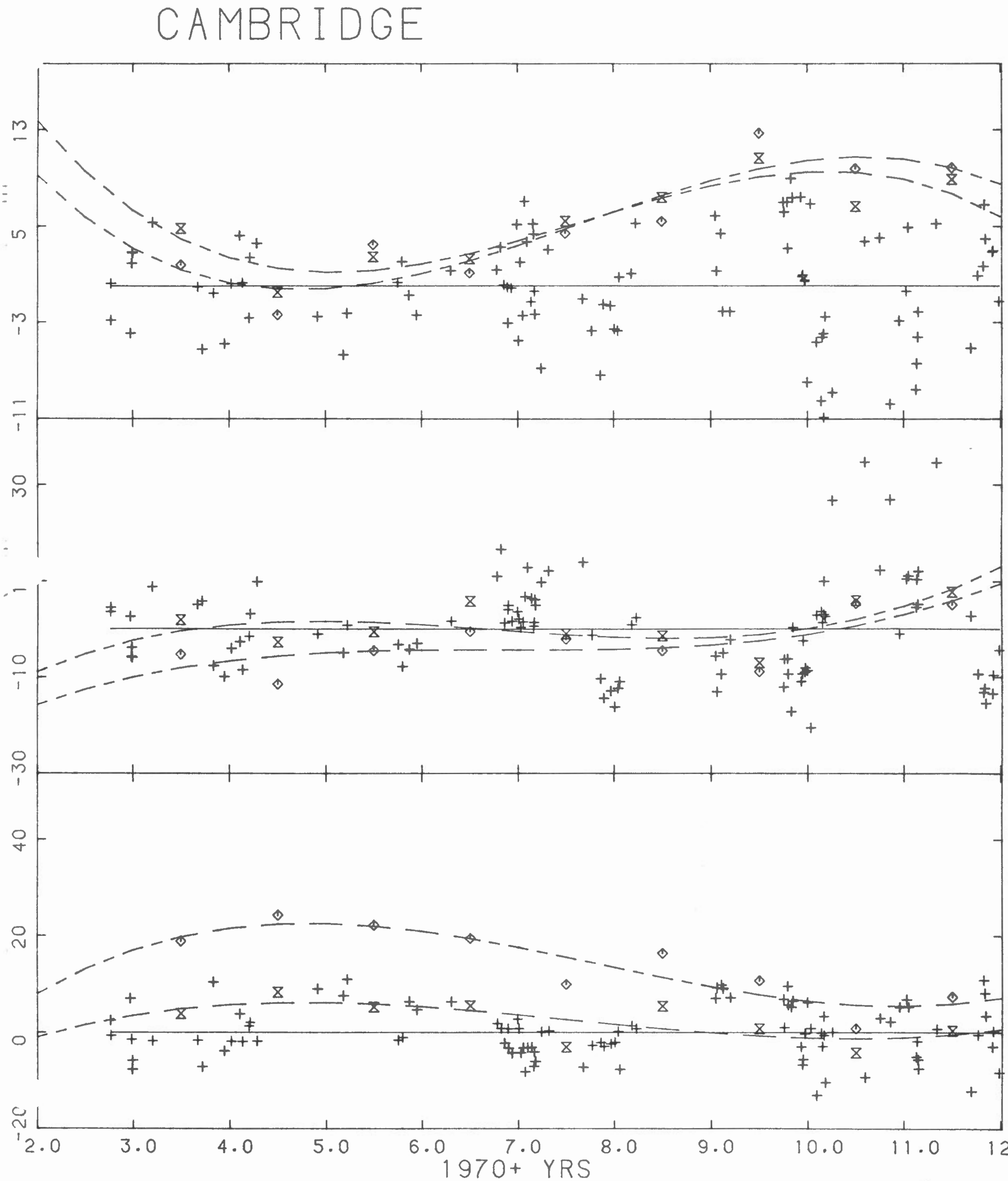
YELLOWKNIFEB

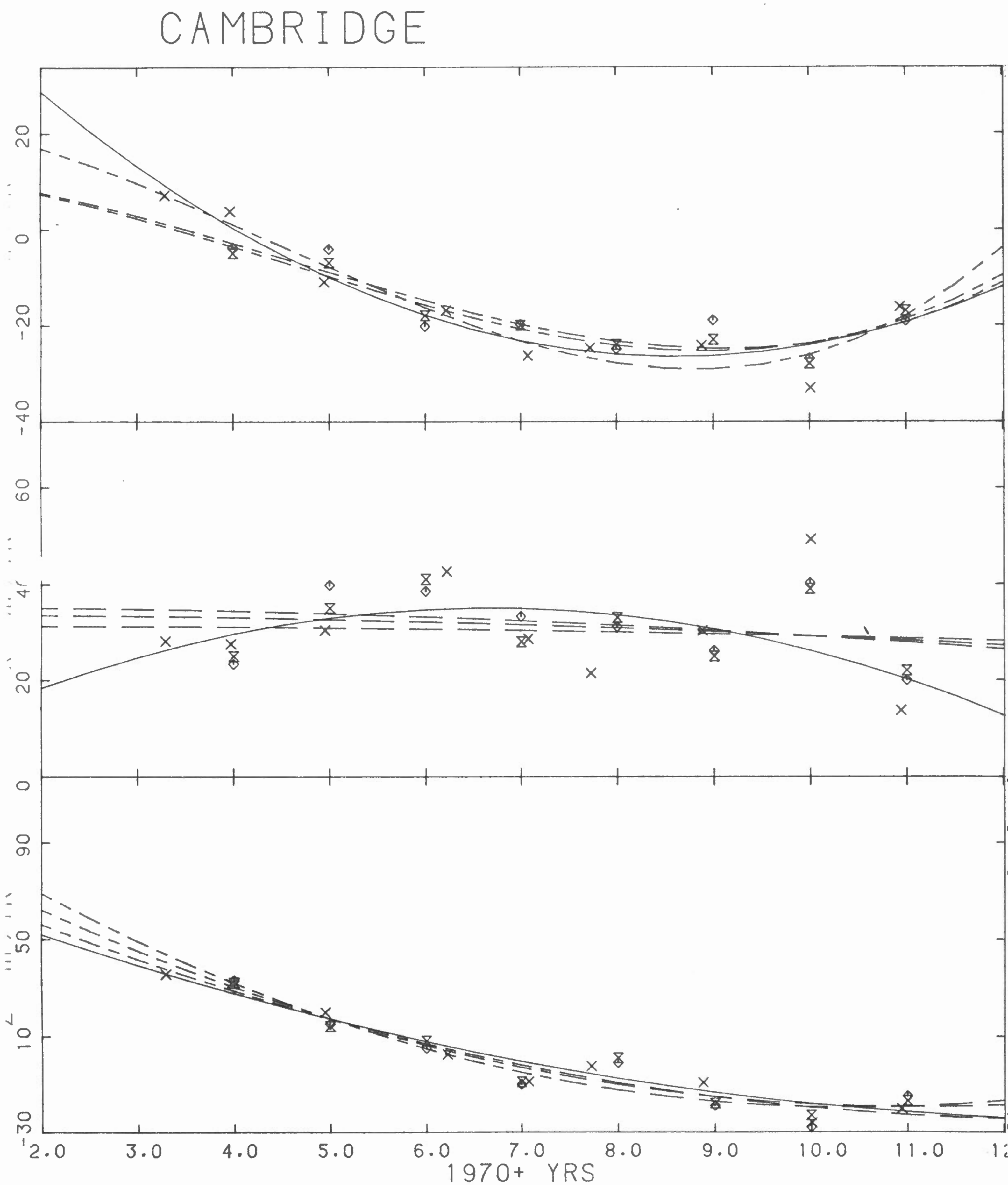


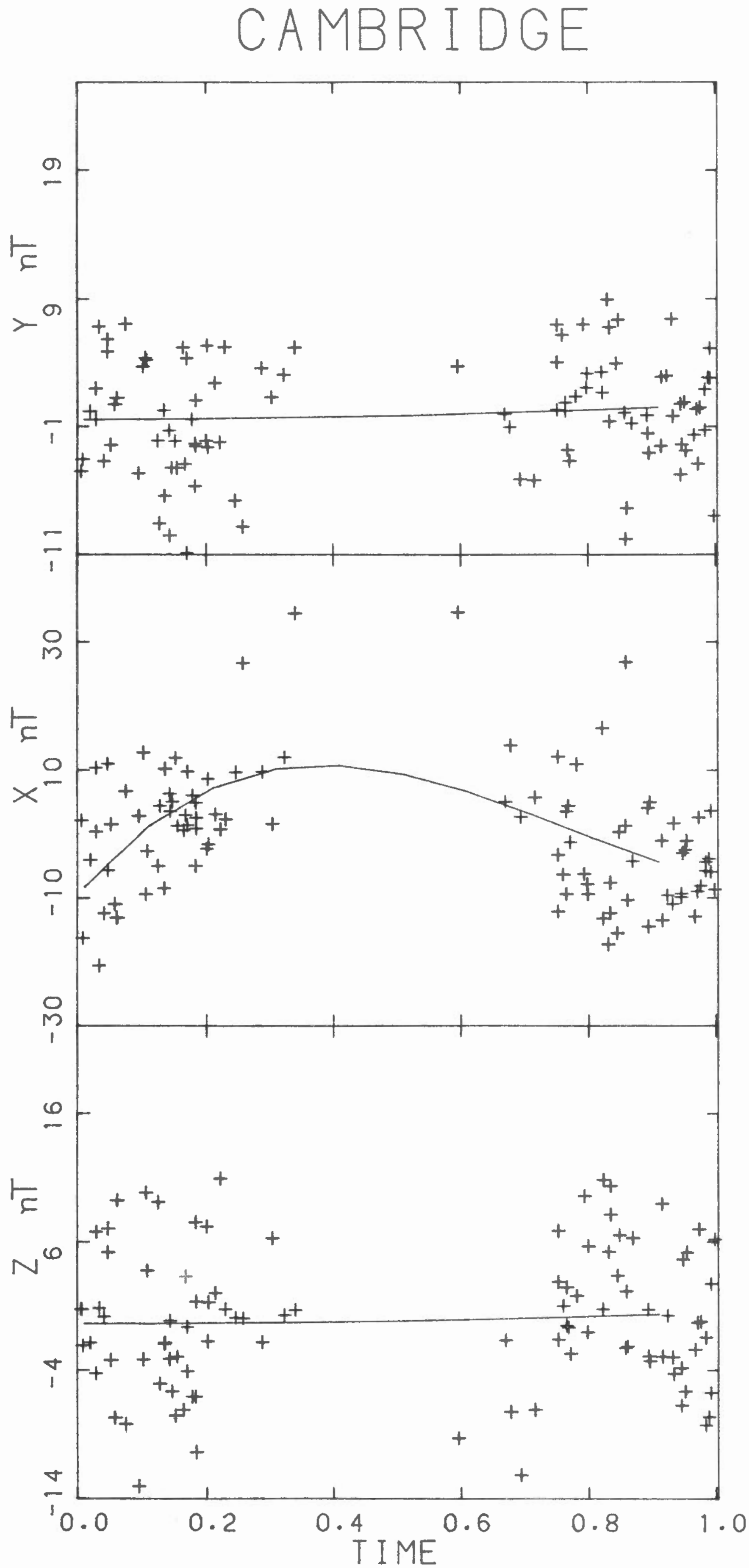

YELLOWKNIFEB
Y' nT/YR
10
-10
-30
-50
X' nT/YR
60
40
20
0
Z' nT/YR
20
0
-20
-40
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970 'RS

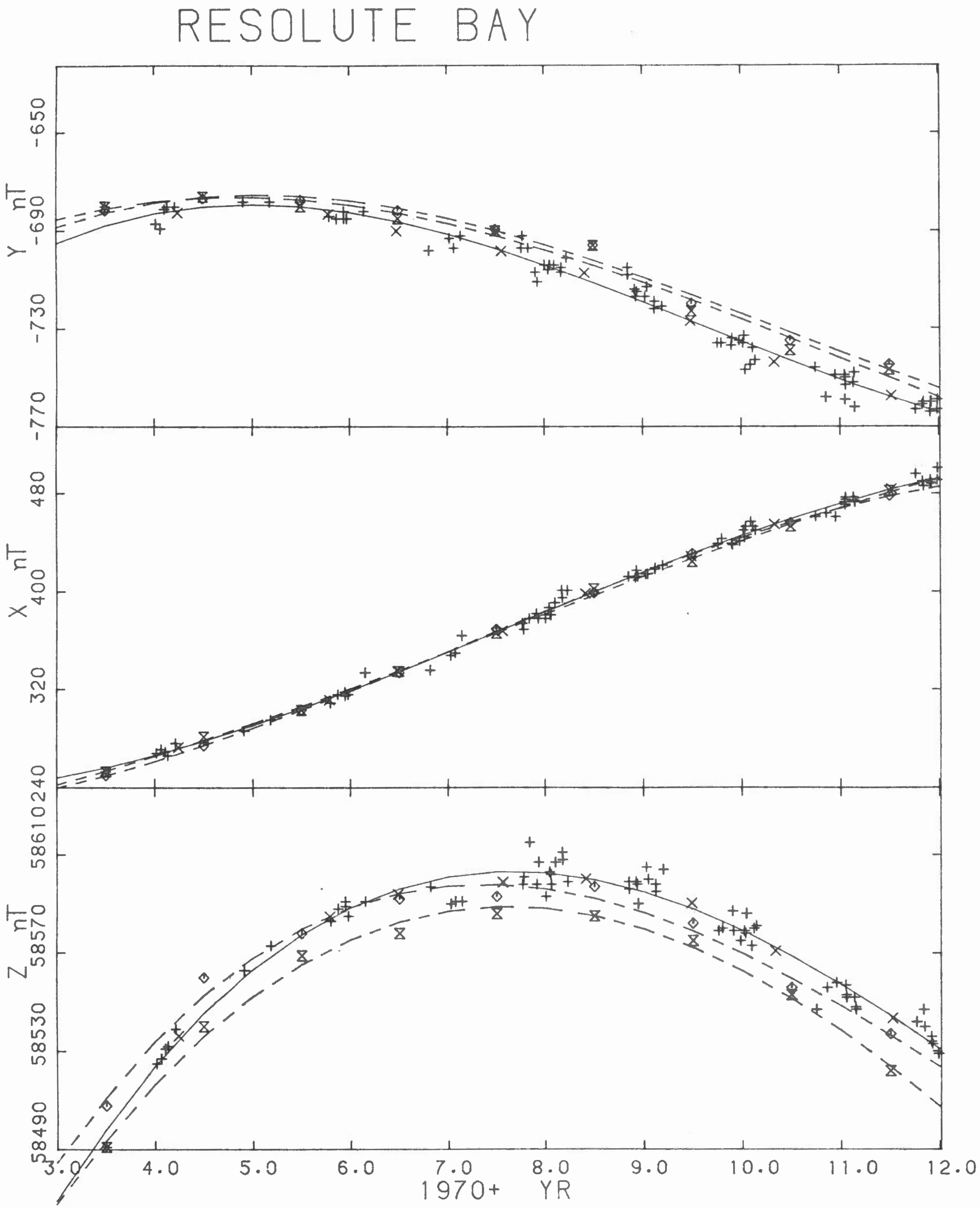

YELLOWKNIFEB
Y nT
30
10
-10
-30
X nT
15
5
-5
-15
Z nT
40
20
0
-20
0.0
0.2
0.4
0.6
0.8
1.0
TIME

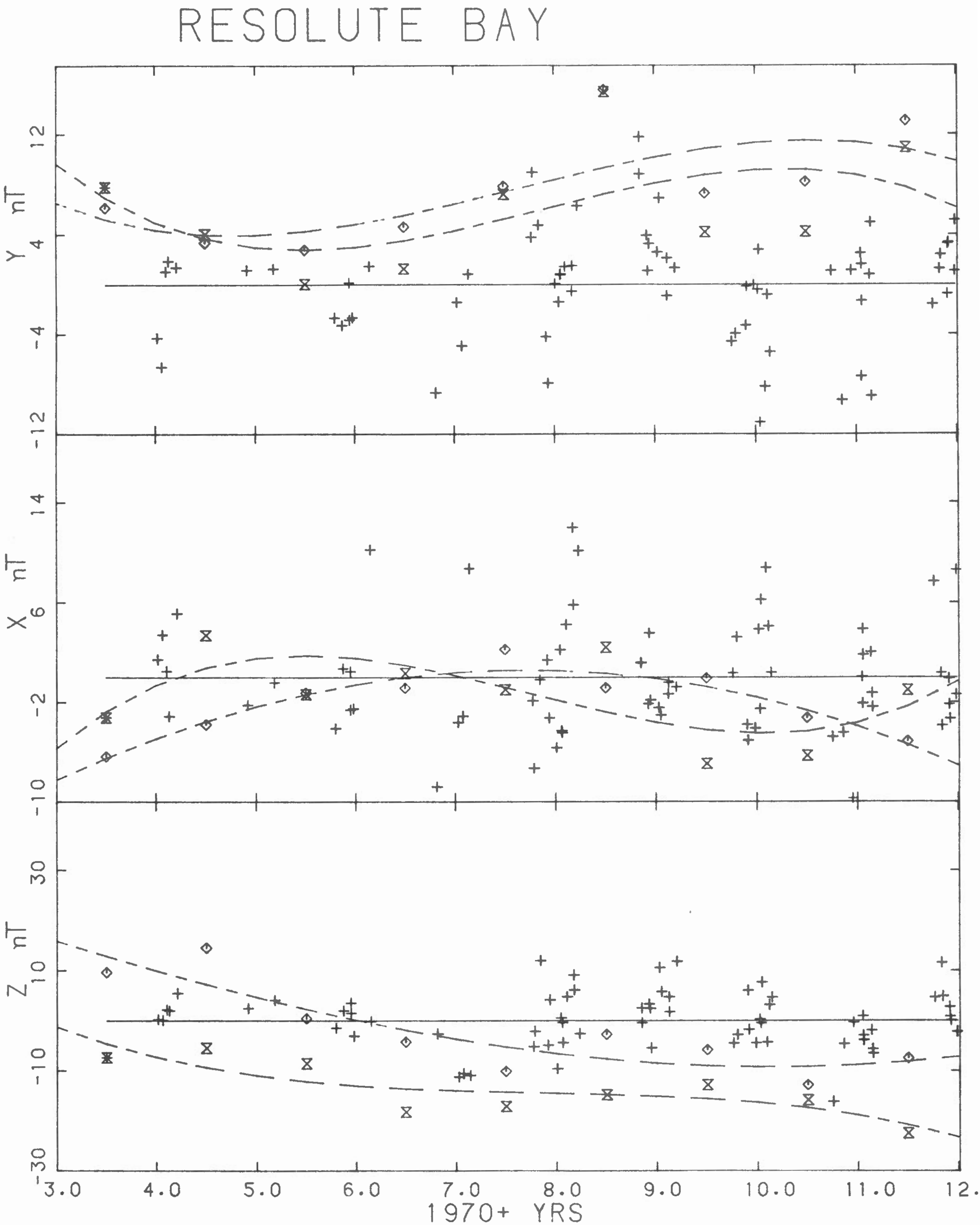

CAMBRIDGE
Y in
1530
1480
1430
1380
X in
2740
2580
2500
Z in
60130
60090
60050
600
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
1970+ YR

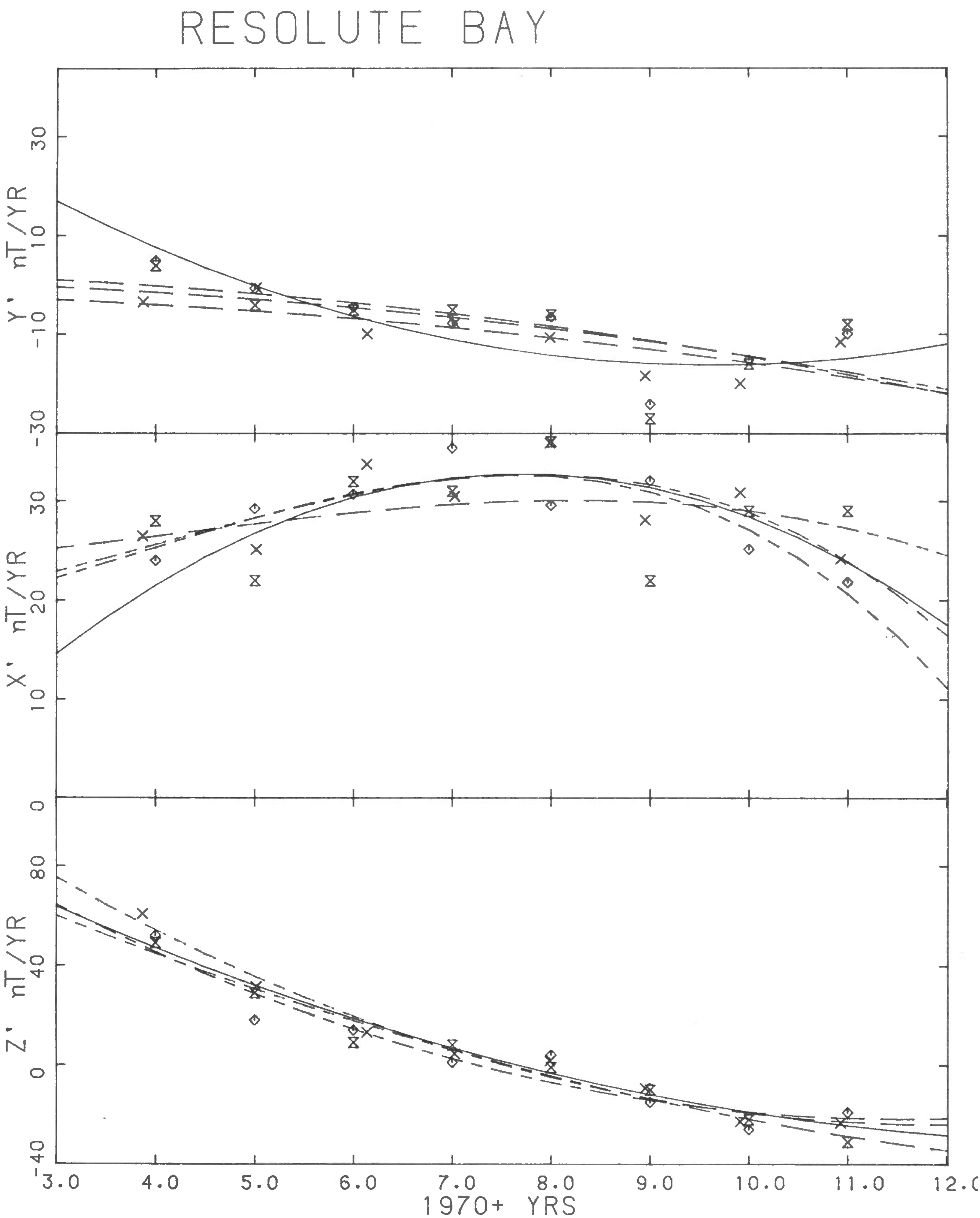

CAMBRIDGE
13
5
-3
-11
30
10
-10
-30
40
20
0
-20
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12
1970+ YRS

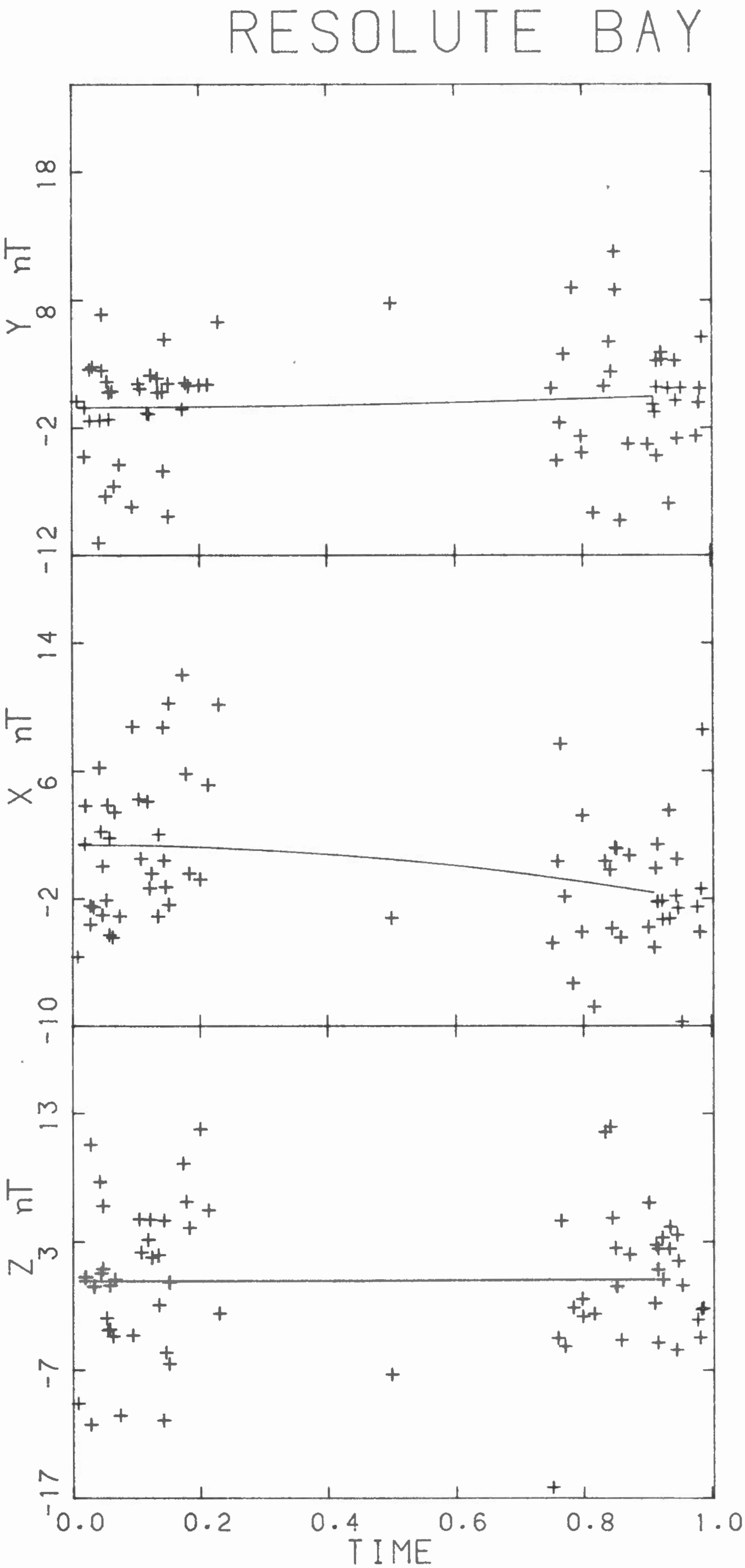

CAMBRIDGE
20
0
-20
-40
60
40
20
0
90
50
10
-30
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
1970+ YRS

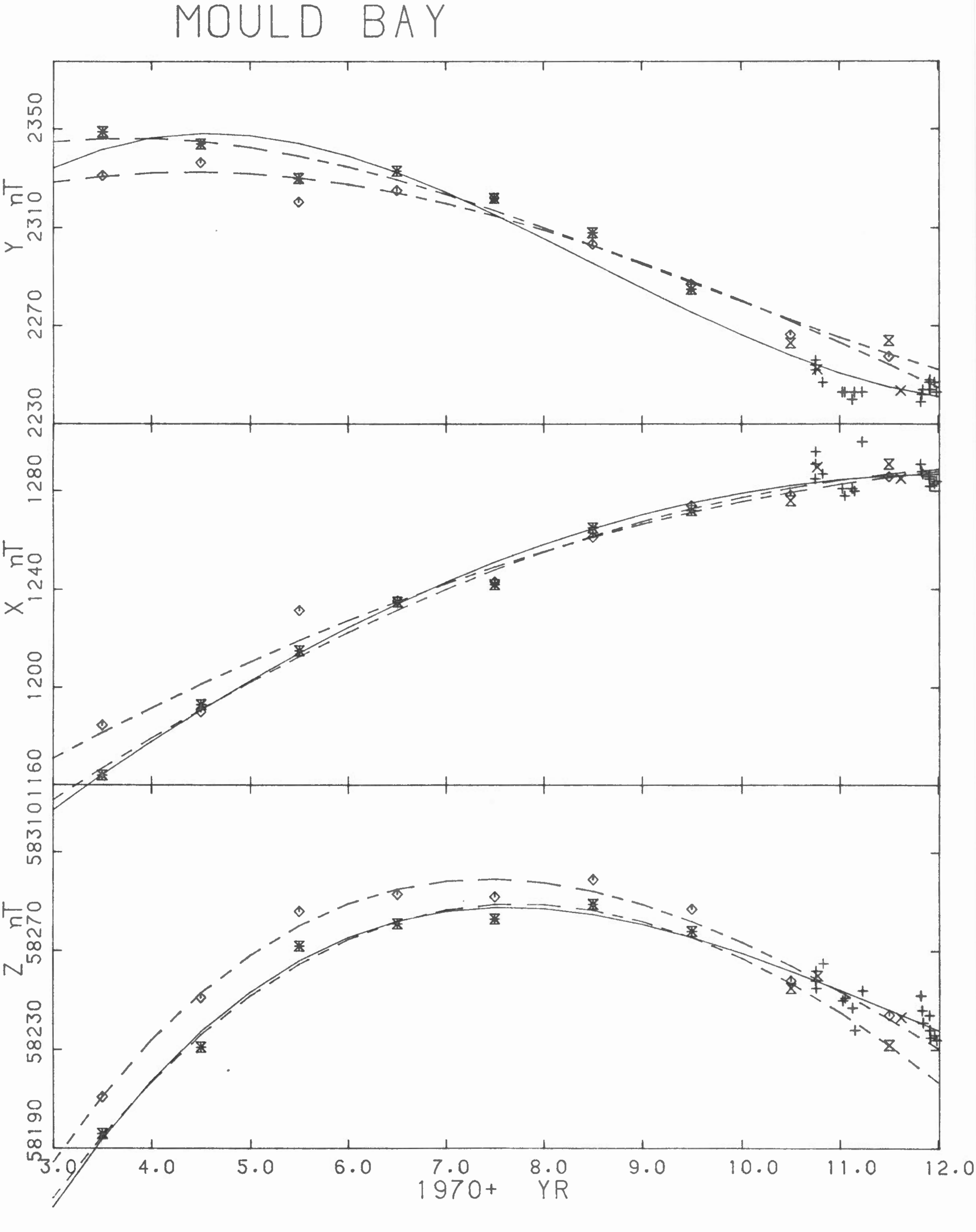

CAMBRIDGE
Y nT
19
9
-1
-11
X nT
30
10
-10
-30
Z nT
16
6
-4
-14
0.0
0.2
0.4
0.6
0.8
1.0
TIME

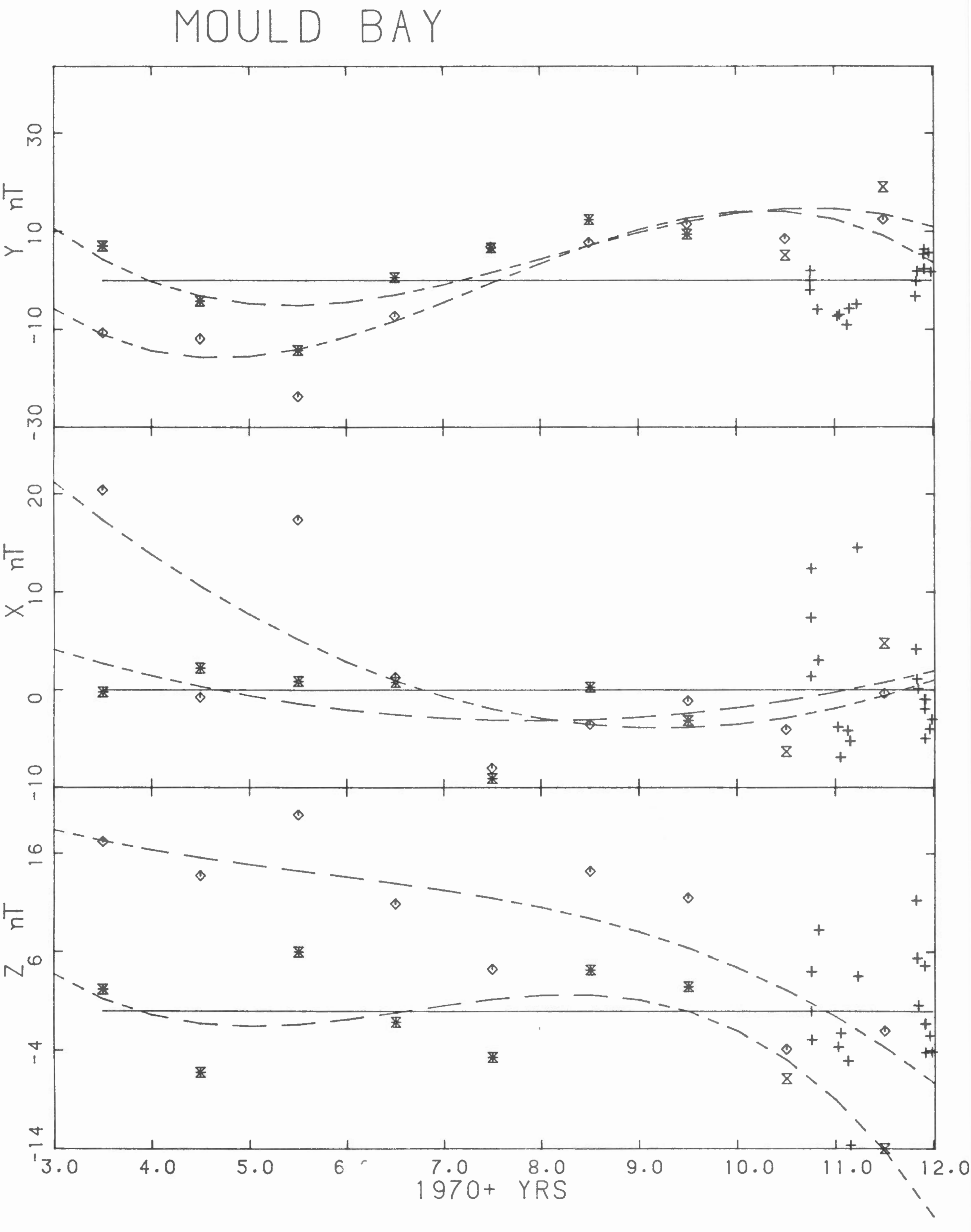

RESOLUTE BAY
Y nT
-650
-690
-730
-770
X nT
480
400
320
240
Z nT
58610
58570
58530
58490
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR


RESOLUTE BAY
Y nT
12
4
-4
-12
X nT
14
6
-2
-10
Z nT
30
10
-10
-30
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.
1970+ YRS

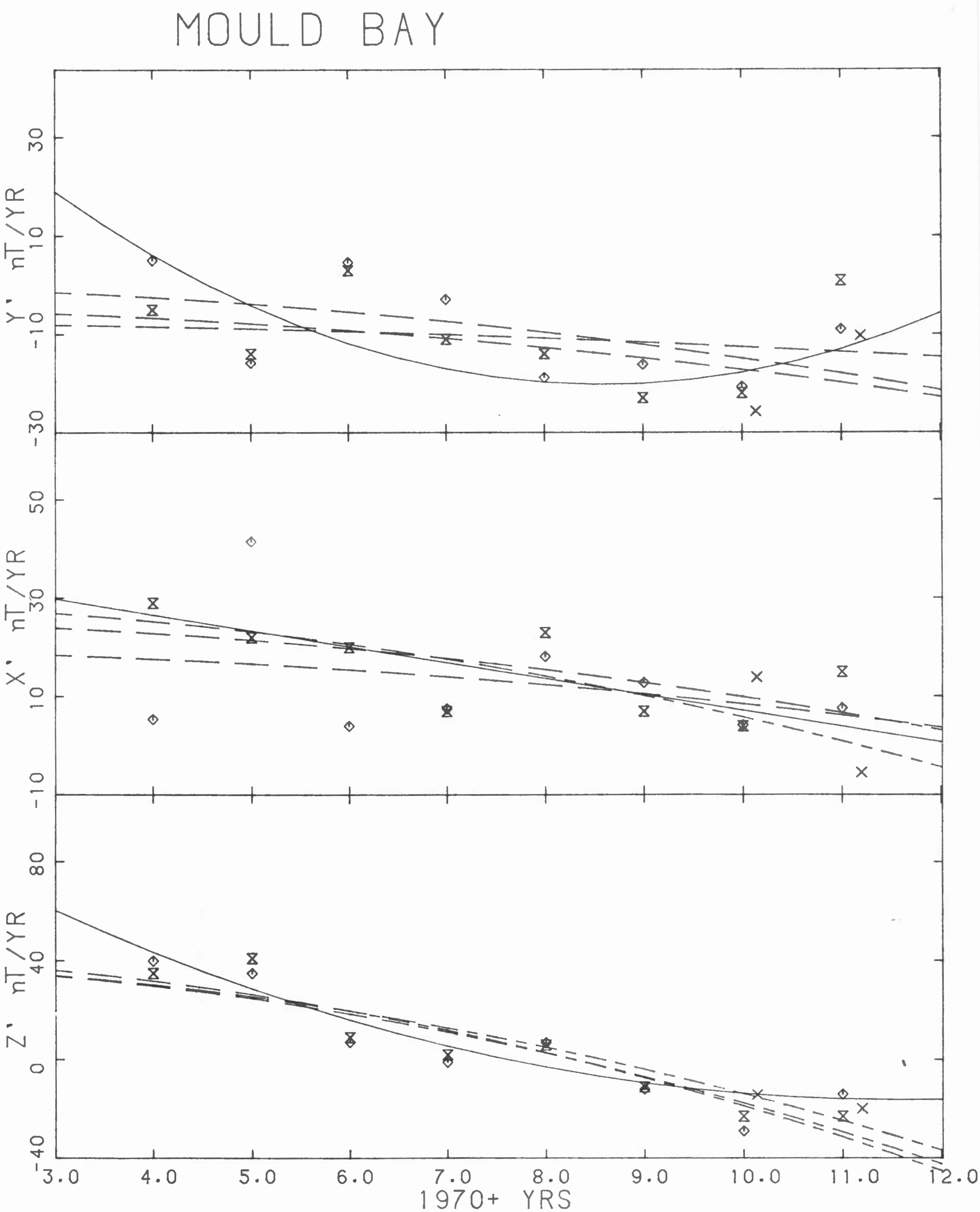

RESOLUTE BAY
Y' nT/YR
30
10
-10
-30
X' nT/YR
30
20
10
0
Z' nT/YR
80
40
0
-40
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS


RESOLUTE BAY
Y nT
18
8
-2
-12
X nT
14
6
-2
-10
Z nT
13
3
-7
-17
0.0
0.2
0.4
0.6
0.8
1.0
TIME


MOULD BAY
Y nT
2350
2310
2270
2230
X nT
1280
1240
1200
1160
Z nT
58310
58270
58230
58190
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YR



MOULD BAY
Y nT
30
10
-10
-30
X nT
20
10
0
-10
Z nT
16
6
-4
-14
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS


MOULD BAY
Y' nT/YR
30
10
-10
-30
X' nT/YR
50
30
10
-10
Z' nT/YR
80
40
0
-40
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
1970+ YRS

MOULD BAY