Low-Dispersion Quick-Look Sensitivity Monitoring. XI.

George Sonneborn and Matthew P. Garhart

SUMMARY

Low-dispersion IUE spectra of photometric standards continue to be analyzed to monitor sensitivity variations in the LWP, LWR, and SWP cameras. This report includes images through 1986.4. There is now limited evidence that the LWP sensitivity is decreasing in the 2400-2600 Angstrom region. This is the spectral region where high-energy electron damage is predicted to have the largest effect on the MgF_2 faceplate transmittance. The SWP and LWR camera responses continue to drop at rates essentially identical to those reported previously. There continues to be no evidence for LWR sensitivity changes correlated with the LWR flare or the camera's reduced level of use.

Introduction and Analysis

The sensitivity of the three active IUE cameras continues to be monitored by analyzing low-dispersion spectra of five standard stars (BD+28° 4211, BD+33° 2642, BD+75° 325, HD 60753, and HD 93521). The sensitivity data bases have been extended to 31 May 1986 (1986.4).

The method of analysis (Holm and Schiffer, 1980) is the one used in previous reports (e.g. Sonneborn 1985; Schiffer 1982). The spectra are ratioed to a reference spectrum for each star and placed in several wavelength bins. The flux ratios are fit using a multiple linear regression to find the rate of change in each bin and the temperature dependence for the camera. The temperature dependence of the sensitivity is assumed to be time and wavelength independent and is fit to the head amplifier temperature (THDA) for that camera.

The multiple linear regression was performed using data for only 4 of the 5 stars, due to large array sizes and memory limitations. BD+33° 2642 was excluded from the regression. All observations in each camera's data base are plotted in the figures.

The analyses show that the three cameras continue to follow the general trends found in previous reports. The results for all three cameras are shown in Table 1 and Figures 1-3. The various symbols represent different stars: PLUS = BD+28° 4211; ASTERISK = HD 93521; DIAMOND = HD 60753; SQUARE = BD+33° 2642; TRIANGLE = BD+75° 325. The plotted flux ratios have been corrected for camera sensitivity temperature dependence.

Results

The LWP data show a small decrease in sensitivity in the 2400-2600 Angstrom region. Figure 1 shows the LWP results along with the regression line for 1980.0 - 1986.4. Laboratory studies (Heath and Sacher 1966; Becher, Reft, and Kernell

1977) have found that radiation damage from high-energy electrons is expected to be most pronounced in this wavelength. The trends in the LWP sensitivity has been rather curious: from 1983 to 1985 the sensitivity in the 2450 Angstrom region apparently went up, or at least leveled off. There had been a significant downward slope of about one to one and a half percent per year. However, about the time the LWP came into heavy use (October 1983), the fluxes in the 2400 - 2700 Angstrom region appear to have increased, but are now decreasing once again. Judging from the general reproducability of the LWP fluxes in the 2150, 2300, and 2900 Angstrom bandpasses, we believe this turn-around is real. We would expect the sensitivity in the 2450, 2600, and 2750 A bandpasses to follow recent trends and decrease at a rate near one percent per year.

There is no evidence in our data which suggests that the LWR sensitivity degredation has changed during the last two and one half years. In the 2400 Angstrom region the camera sensitivity has decreased about 25% over the course of the IUE mission. The changes in the 2600 and 2900 Angstrom bandpasses are slightly smaller than that at shorter wavelengths. The LWR data are shown in Figure 2 with the 1980.0 - 1986.4 regression lines. Only data taken at the 5.0 Kv UVC setting have been used in the analysis.

The SWP sensitivity continues to show the same small decrease in 150 Angstrom bandpasses centered at 1300, 1550, 1850 Angstroms. The 1979.5 starting date for the linear regression was chosen to exclude the period of rapid sensitivity decrease shortly after launch. Figure 3 shows the SWP regression lines for the 1979.5 - 1986.3 fit superposed on the complete set of SWP data.

We have periodically reported on the behavior of the camera temperature (THDA) as a function of time. The THDA data from the three data bases and straight lines fit to each are shown in Figure 4. The mean temperatures at 1986.4 are 9.9 °C, 14.7 °C, and 9.7 °C for the LWP, LWR, and SWP, respectively. The least squares coefficients for the straight lines are

$$\text{LWP THDA} = -506.3 + 0.262t,$$

$$\text{LWR THDA} = -634.0 + 0.324t,$$

$$\text{SWP THDA} = -420.7 + 0.217t,$$

where t is in years. However, the linear dependences may be misleading, since the LWR and SWP data from about 1980 to 1986.4 and the LWP data from about 1982 to 1986.4 show no obvious upward trend in Figure 4. It would appear that the mean THDA for the cameras has been constant for the past four to six years.

References

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Heath, D.F., and Sacher, P.A. 1966. Applied Optics, 5, 937.

Holm, A.V., and Schiffer, F.H. 1980. NASA IUE Newsletter No. 9, p. 8.

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Table 1.

Results of SWP, LWR, and LWP sensitivity analysis - June 1986

SWP camera

Temperature dependence: −0.48±0.04 %/°C
RMS error in an individual observation: 3.3%
247 observations of 4 stars (data through April 1986)

Time dependence (%/year)

	1979.5 through				
wavelength	1986.3	1985.3	1984.8	1984.2	1983.6
1300±75A	−0.66±0.06	−0.69±0.08	−0.73±0.09	−0.72±0.13	−0.46±0.16
1550 "	−0.22	−0.17 "	−0.20 "	−0.16 "	+0.16 "
1850 "	−0.69	−0.63 "	−0.68 "	−0.86 "	−0.63 "

LWP camera

Temperature dependence: −0.25±0.04 %/°C
RMS error in an individual observation: 3.5%
175 observations of 4 stars (data through May 1986)

Time dependence (%/year)

	1980 through				
wavelength	1986.4	1985.3	1984.8	1984.2	1983.4
2150±75A	+0.20±0.09	+0.29±0.11	0.00±0.13	−0.09±0.15	−0.14±0.21
2300 "	−0.22 "	−0.06 "	−0.29 "	−0.61 "	−0.91 "
2450 "	−0.42 "	−0.27 "	−0.61 "	−1.05 "	−1.42 "
2600 "	−0.48 "	−0.13 "	−0.48 "	−0.84 "	−1.12 "
2750 "	−0.11 "	+0.24 "	+0.02 "	−0.03 "	−0.13 "
2900 "	+0.11 "	+0.39 "	+0.23 "	+0.15 "	+0.07 "

LWR camera

Temperature dependence: −0.70±0.06 %/°C
RMS error in an individual observation: 4.2%
250 observations of 4 stars (data through May 1986)

Time dependence (%/year)

	1980 through				
wavelength	1986.4	1985.3	1984.8	1984.3	1983.6
2400±150A	−2.49±0.08	−2.23±0.10	−2.38±0.11	−2.45±0.09	−2.30±0.11
2600± 50A	−1.73 "	−1.69 "	−1.77 "	−1.36 "	−1.19 "
2900±150A	−1.73 "	−1.84 "	−1.87 "	−1.35 "	−1.13 "

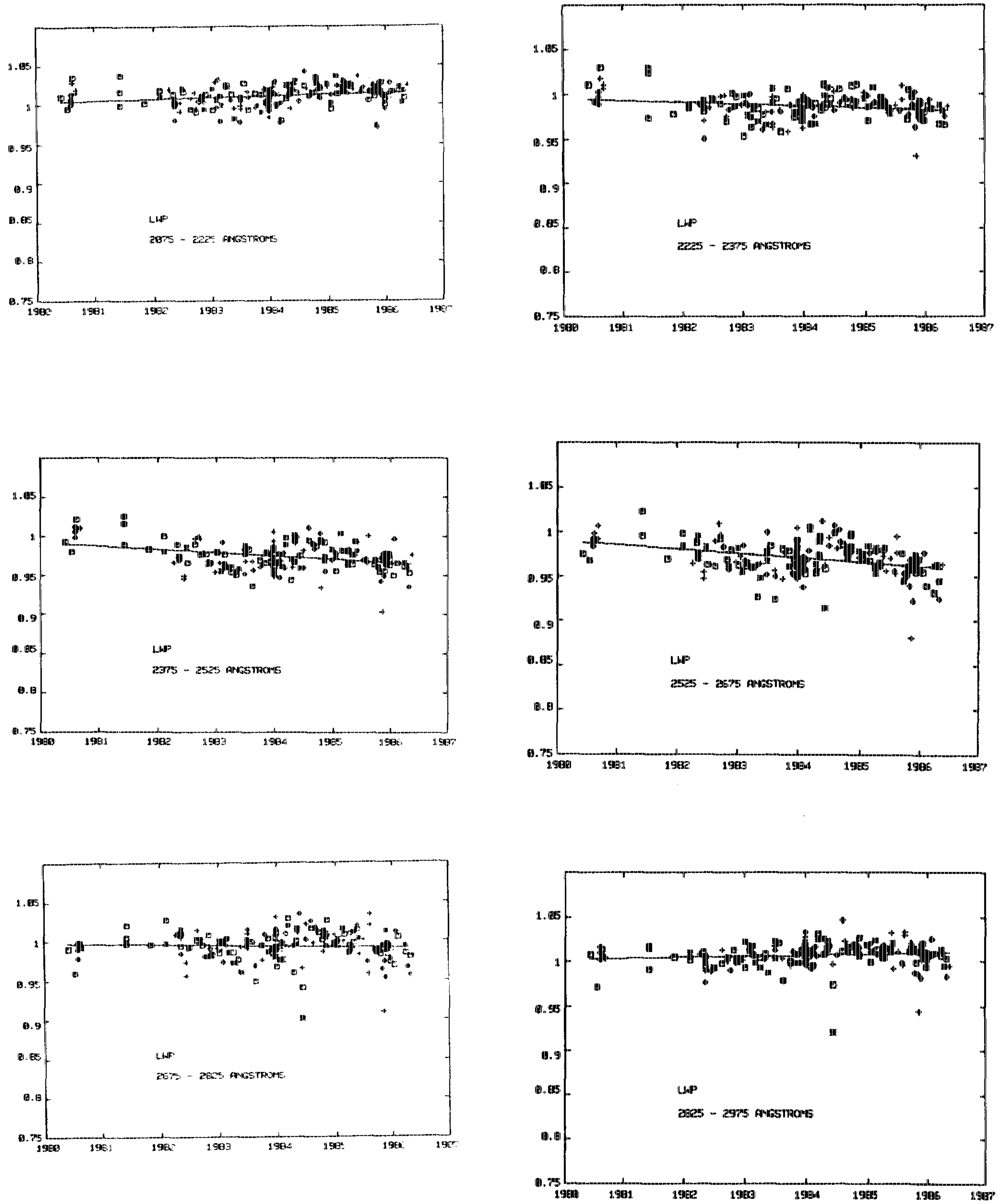

Figure 1 - Normalized LWP fluxes in six bandpasses for five standard stars are plotted as a function of time. The straight line fits to the data were determined by a multiple linear regression with the full set of data. The various symbols, defined in the text, represent different stars.

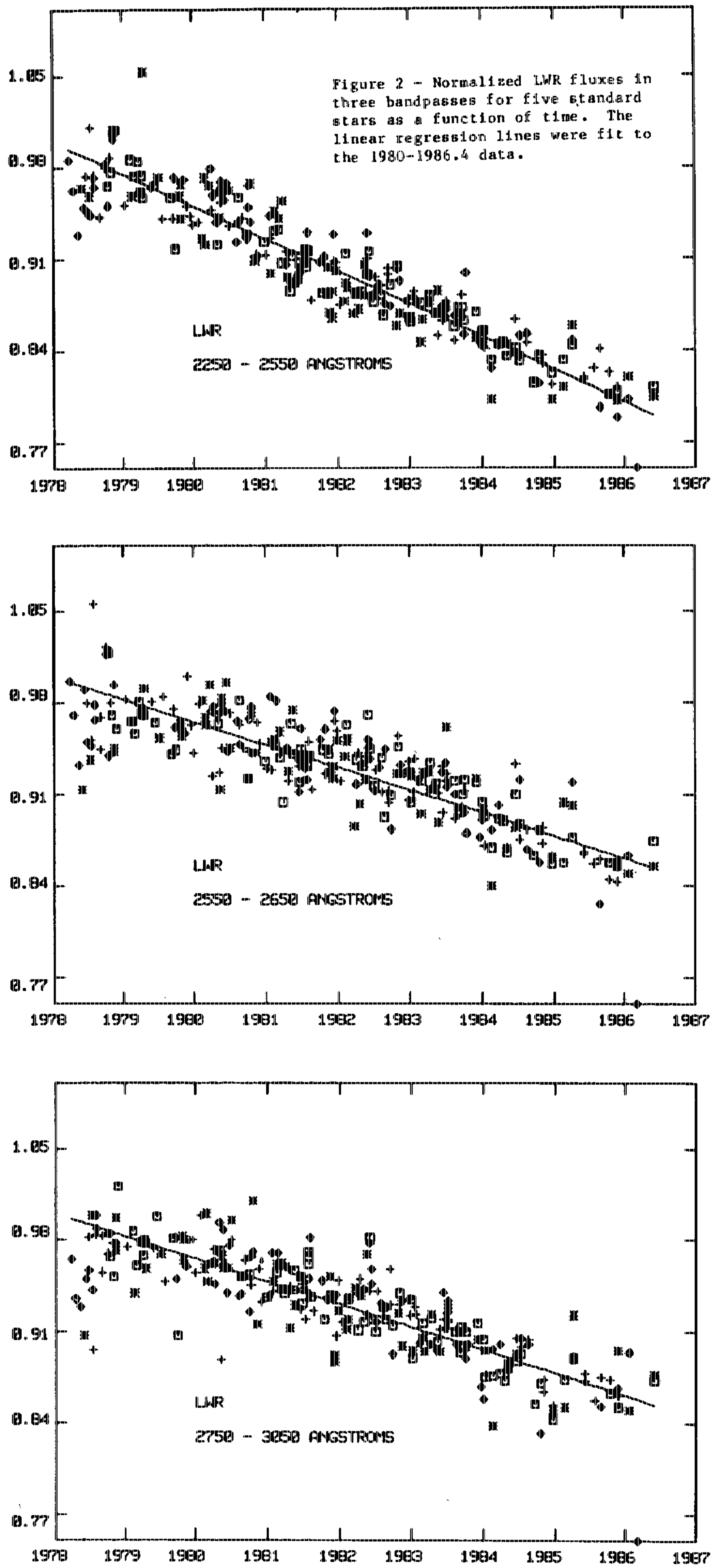

Figure 2 - Normalized LWR fluxes in three bandpasses for five standard stars as a function of time. The linear regression lines were fit to the 1980-1986.4 data.

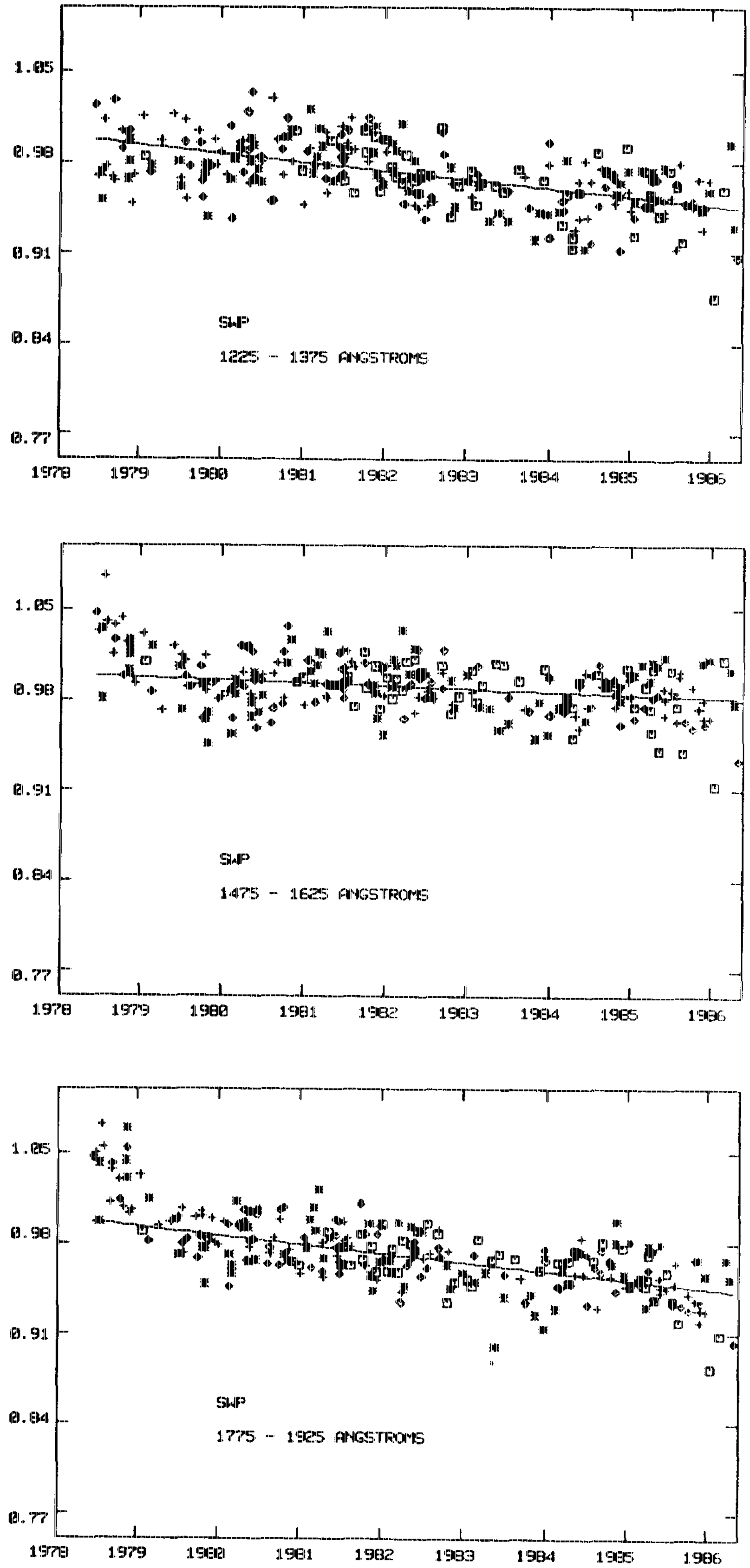

Figure 3 - Normalized SWP fluxes in three bandpasses for five standard stars as a function of time. The linear regression lines were fit to the 1979.5-1986.4 data.

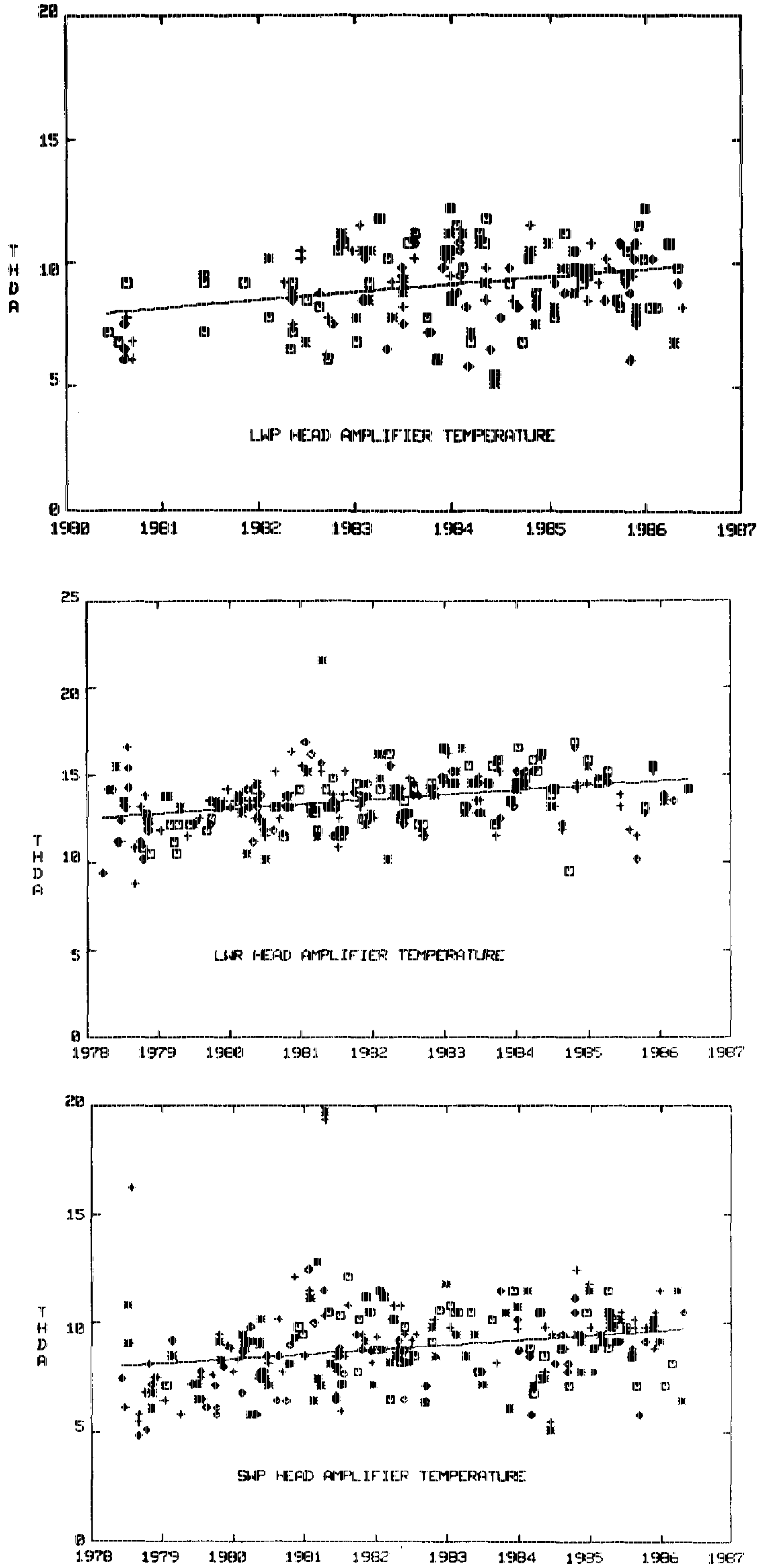

Figure 4 - The LWP, LWR, and SWP camera head amplifier temperatures (THDA, °C) are shown as a function of time.