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Nimbus-7 Earth Radiation Budget Compact Solar Data Set User's Guide

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1. INTRODUCTION

The Nimbus-7 Earth Radiation Budget (ERB) solar measurements extend over 15 years from November 16, 1978 to mid-December 1993. Included are the peaks of solar cycles 21 and 22. The ERB experiment was designed to measure three components of the Earth's radiation budget: the total irradiance from the Sun plus the broad spectral components, the Earth's reflected solar radiation, and the thermal radiation emitted by the Earth. Initially planned to operate only 1 or 2 years, both the Nimbus-7 satellite and the ERB experiment have operated some 15 years. The calibrated Earth flux and total solar irradiance products have been well documented and widely distributed (Jacobowitz, et al., 1984; Kyle, et al., 1985, 1993a,b, 1994; Hoyt, et al., 1992). However, the original data set left the raw counts solar measurements scattered over about 170 tapes where they were mixed with the Earth flux measurements. These raw solar counts have now been gathered together for easier review. This compact data set is described by the present document.

The present calibration procedures are described in some detail in Hoyt, et al. (1992) and Kyle, et al. (1993b). The condensed solar data set and this document are meant for those individuals who wish to examine the actual measurements. The user of this data set should also obtain and read Kyle, et al. (1993b), although a few excerpts from this document will be repeated below.

The ERB solar telescope contained ten sensors but only seven real spectral pass bands; these are shown in Table 1. Channels 1 and 2 are similar to the Earth-viewing channel 13 and measure most of the incident solar spectrum. Channels 3 and 10c have no covering and are, therefore, sensitive to an even broader spectral region. A series of overlapping spectral bands are measured by channels 4 to 9. Only channel 10c (c for cavity) had on-board calibration capabilities. The data from channels 1-9 have not been widely used because of uncertainties in the inflight characterization of these sensors (Kyle et al., 1993b). Channel 10c is much better understood (Hoyt et al., 1992).

Since the channel 10c data have the widest distribution, two compact solar counts data sets were formed. The larger contains the measurements from all ten channels and is called the Summary Solar Tape (SST) set. There are fourteen 38,000-bpi, 3480 tape cartridges, about one per year, with 1978 and 1979 measurements combined on one tape as are the 1992 and 1993 results. The channel 10c Solar Tape (CST) set consists of two tape cartridges plus the calibrated orbit-by-orbit irradiances and some inflight calibration data on PC computer disks.

2. THE MEASUREMENT ENVIRONMENT

2.1 Sun in View

The ERB instrument is mounted on the leading (front) side of the Nimbus-7 satellite with its solar telescope facing forward and its Earth flux channels looking towards the Earth. The satellite is in a nearly circular, 955-km high, Sun-synchronous orbit, with a retrograde inclination to the equator of 99.3°. The orbital period is 104 minutes so there are 13.85 orbits per day. The solar sensors see the Sun once per orbit as the satellite crosses the sunrise terminator near the South Pole.

Table 1. Characteristics of ERB Solar Channels			
Channel	Wavelength Limits (μm)	Filter	Noise Equivalent Irradiance (W · m^{-2})
1*	0.2 to 3.8	Suprasil W	1.77 x 10^{-2}
2*	0.2 to 3.8	Suprasil W	1.77 x 10^{-2}
3	(0.2 to) 50	None	1.43 x 10^{-2}
4	0.536 to 2.8	OG530	1.94 x 10^{-2}
5	0.698 to 2.8	RG695	1.91 x 10^{-2}
6	0.398 to 0.508	Interference Filter	3.58 x 10^{-2}
7	0.344 to 0.460	Interference Filter	5.73 x 10^{-2}
8	0.300 to 0.410	Interference Filter	7.55 x 10^{-2}
9	0.275 to 0.360	Interference Filter	0.94 x 10^{-2}
10c†	(0.2 to) 50	None	2.39x 10^{-2}

The unencumbered field of view for all channels is 10°; the maximum field is 26° for channels 1 through 8 and 10c. The maximum FOV for channel 9 is 28°. All are types of Eppley wire-bound thermopiles.

* Channels 1 and 2 are redundant; Channel 1 is normally shuttered. Its shutter, when opened for comparison measurements, covers channel 3.

† Channel 10c is a self-calibrating cavity channel added to Nimbus-7 and replacing a UV channel (0.246 to 0.312 μm) on Nimbus-6.

The solar sensors view cold, deep space during most of the orbit and these data are of interest only for calibration purposes. All of the ERB data are recorded on the ERB Master Archive tapes (MATs). There is one MAT for every three data-day period. The wide-field-of-view (WFOV) Earth flux measurements and the solar observations are pulled off onto a monthly solar and Earth flux data tape (SEFDT). The measurements are grouped into 16-second packages called major frames. Thus, there are 390 major frames in each 104-minute orbit, but only 55 major frames per orbit of solar data are placed on the SEFDTs. There are 51 major frames centered at t_0, the time at the middle of the solar observation. For calibration purposes, there are also two major frames at (t_0-minus 13 minutes) and two at (t_0 plus 13 minutes). These 55 major frames, per orbit of solar data have been collected from the SEFDTs and placed on the SST and CST compact tapes for ease of access.

2.2 Scheduling

Solar measurements were made from November 1978 to December 1993 but scheduling and other problems caused some data gaps. The major gaps are enumerated and discussed in Table 2. At launch, the Nimbus-7 satellite carried instruments for eight different scientific programs. There was not enough power to operate all of these instruments simultaneously so they were placed on a powersharing schedule. For the first several years, the ERB instrument was normally on a 3-day-on/1-day-off schedule. In later years, when a number of the other instruments had failed, the ERB instrument was kept on full time.

Table 2. Major ERB Events

Date	Event
November 16, 1978	Initial turn on. ERB in 3-day-on/1-day-off power sharing schedule with other Nimbus-7 experiments. From time to time, the schedule varied somewhat.
December 10, 1978 through April 13, 1979	ERB scanning activity is curtailed because it interfered with the short-lived LIMS experiment which studied trace gases in the stratosphere. 12/10 to 12/30/78 — Scanning on 2-day-on/2-day-off schedule; WFOV and solar on 3-day-on/1-day-off schedule 12/30 to 3/9/79 — Further curtailment; no scanning near the north pole, nor in the northern hemisphere at night 3/10 to 3/31/79 — global scanning, 2-day-on/2-day-off schedule 4/1/ to 4/13 — ERB on 1-day-on/1-day-off mode but no scanning
April 14, 1979	ERB and scanner returns to 3-day-on/1-day-off schedule, but with occasional variations
June 22, 1980	Scanner chopper wheel stops. This terminates useful scanner measurements. Efforts to restart the chopper continued through July 18. The noise in channel 10c decreased noticeably after July 18.
September 11, 1983	ERB put on full-time on schedule
April 18, 1984	ERB returns to 3-day-on/1-day-off schedule
October 28, 1984	ERB back on full-time on schedule
April 9 to June 23, 1986	No Earth flux measurements, but ERB was on for 20 minutes on most orbits for solar measurements. This allowed the CZCS experiment additional power for its end-of-life program
April 22 to August 20, 1987	Earth flux measurements taken only on alternate days to conserve power. On the off days, ERB was on for 30 minutes per orbit to make solar measurements; however, these measurements were noisy
August 24, 1987	ERB back on full-time on schedule
September 24-28, 1989	ERB sensor data blanked out by a temporary electronics problem possibly caused by a cosmic ray. Normal data transmission recommenced on the afternoon of September 28.
January 4-11, 1992	The ERB solar telescope refused to move from $\gamma=14°$ to $15°$ in order to track the Sun, but it would move in the other direction. Several tests were made and finally on January 11, the telescope moved to $\gamma=15°$. Very little data were lost. The telescope has moved normally since that time.
January 15-23, 1992	Some of the ERB sensor data became meaningless, then it all became saturated. Data alternated between meaningless signals and saturation. This was probably caused by energetic particles damaging the electronic circuits. Normal operation resumed on January 23.

Table 2. Major ERB Events	
Date	Event
June 17-September 2, 1992	The Sun was not clearly visible during this period. The solar telescope can move only over the range, $\gamma = \pm 20°$. The precession of the orbit over the years combined with the seasonal progression of the Sun relative to the satellite moved the Sun out of the unrestricted field of view of channel 10c during this period.
January 25, 1993	The continued precession of the orbit again moved the Sun out of the unrestricted field of view of channel 10c.
February 9, 1993	ERB electronics turned off.
Fall 1993	October 4 ERB turned on for warmup. October 12 Started recording data. October 17 Electronic problems started. October 25 Sun in view but data bad. October 27 Problems, no data products through November 11. November Some or all data missing on November 13, 14, 24, 25, 26, 27. December 12 Sun at edge of clear field of view. December 31 End of recorded data. January 4, 1994 ERB turned off.
April 10, 1994	April 10, 1994 Spacecraft stopped communicating. Brief random contacts occurred later. Everything appeared normal except for the communications problem.

The satellite orbit drifted slowly, and eventually this moved the Sun out of the solar sensors field-of-view. This terminated the experiment in December 1993. The direction of the Sun with respect to the satellite also varied seasonally. This caused the Sun to be out of view during the summer of 1992 and during almost all of 1993. Intermittent electronic problems also caused the loss of a few days of data during the later years. The worst case occurred in the fall of 1993 when approximately 3 weeks of possible measurements were lost due to electronic problems. It is theorized that the electronic problems were initialized by energetic particles temporarily damaging one or more solid-state components in the ERB electronics. In each case, the ERB electronics returned to normal after a period of time.

Only the MATS were made for October 1994. The data were not considered of general interest because of the poor quality of much of it, so no SEFDT was produced for this month. SEFDTs were produced for November and December 1994. From November 12 on, missing data occurred due both to data transmission problems and instrument electronic problems.

2.3 Off-Axis Pointing

The solar sensors have a 10° unobstructed field-of-view (FOV) and it was planned that the Sun would pass through, or close to, the center of the FOV during the measurement. If this does not occur, the solar measurement is termed "off-axis." At the time of the measurement, the satellite to Sun direction varies seasonally. To compensate for this, the ERB solar telescope is moved in 1° steps to match the solar direction. Ideally this would cause the Sun to pass within one-half degree of the FOV center for all measurements. The pointing of the telescope away from the satellite orbit plane is given by the γ-angle, and this angle is recorded in the ERB data stream at the satellite. In 1989, it was discovered that the ERB scale that recorded the γ-angle had slipped, during the experiment, by 1° (Hoyt et al., 1992; Kyle et al., 1993b). Thus, during much of the experiment, the Sun had passed about 1° to one side of the center of the FOV.

After this discovery, no effort was made to correct the pointing of the solar telescope. But data were collected to allow corrections to be accurately made for off-axis measurements. To date, the actual corrections have only been made for channel 10c, but they can also be made for the other channels. As discussed in Kyle et al. (1993b) and in Section 3.2, some of the sensors (channel 5 for instance) are quite sensitive to off-axes pointing.

The channel 5 solar transit measurements, in counts, for three different off-axis angles are shown in Figure 1. The Sun was quite stable during this period so that the off-axis angle, g, is the major variable. Channels 1-9 had fairly reflective baffles. This causes a local minimum in the signal when the Sun is in the center of the field of view. Away from the center, the increased reflection from the baffles actually causes the signal to rise until the Sun begins to leave the clear field of view. Notice that the local minimum value increases as the off-axis angle increases until the local minimum vanishes entirely. The shape of the solar transit curve varies from channel to channel and a few such as channel 9, show practically no local minimum at any angle.

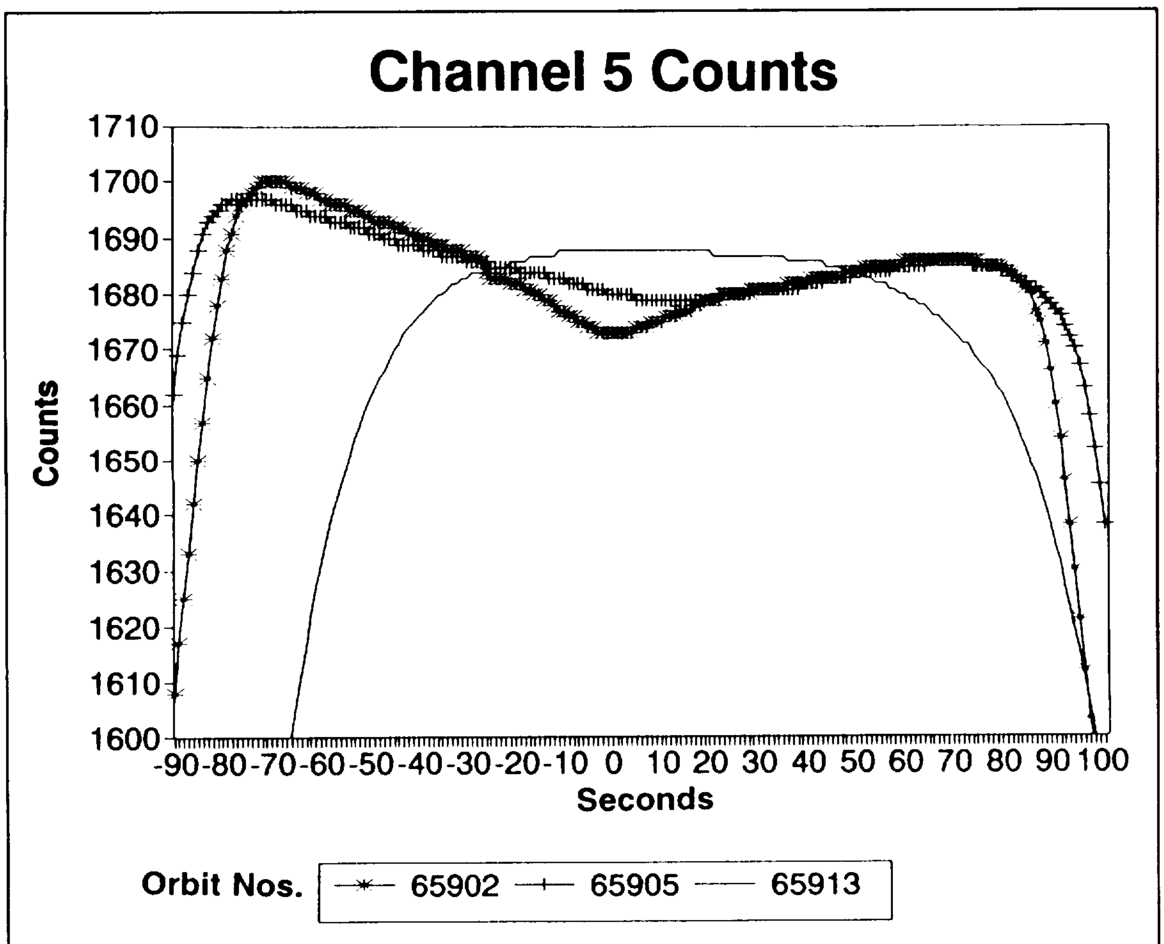

Figure 1. Channel 5 solar transits for off-axis angles of (g = -0.1°, orbit 65,902), (g = -1.2°, orbit 65,905), and g = -4.2°, orbit 65,913).

In the SEFDT algorithm, the on-Sun time t_0 was determined by finding the center of the local minimum on channel 5. If no minimum was found, t_0 was set to the southern terminator for the selection of solar data records. The true on Sun time occurs when the solar elevation angle (see Table 13) passes through zero. Since problems occurred from time to time with the recorded value of this angle, this method was not used in the production program. Channel 10c is a cavity radiometer with black painted baffles and it shows a signal maximum at t_0. When the channel 10c data were reprocessed (Hoyt et al., 1992), t_0 was taken as the time associated with this maximum.

Any reanalysis of the solar data should include an analysis of the off-axis response of the channels being studied. An attempt was made to measure these before launch, but the solar simulator used was not stable enough to yield accurate results. Therefore, several inflight tests were made to measure the response as a function of the off-axis angle, g. These tests and the measured response function for channel 10c are described by Kyle et al. (1993b). A summary appears in Hoyt et al. (1992). The test data are in both the SEFDT and SST archives. We plan to also determine the response functions for the other solar channels, but this has not yet been done.

3. THE SUMMARY SOLAR TAPES (SST)

3.1 Contents Summary

These tapes contain all of the solar channel data that were on SEFDTs. This includes the actual solar channel read out in counts, housekeeping data, and orbital averages. The housekeeping data include the time, geometric angles, sensor temperatures, and the Earth-Sun distance. The orbital averages are collected in separate files and include the mean sensor counts and the calculated irradiances when the Sun is near the center of the field of view.

There were numerous problems with the MAT and SEFDT calibration algorithms. After considerable study, the ERB Nimbus Experiment Team (NET) decided to process the data with the existing, imperfect MAT and SEFDT algorithms. As improved algorithms were developed, the MATs, and in some cases the SEFDTs, were used as input tapes for the reprocessing. Only the corrected Earth flux data were placed back on the SEFDTs using a program called SEFDT FIX. Funding for the Earth flux calibration program was eventually terminated; thus, the Earth flux irradiances for channels 12-14 are only corrected through October 1987 (see Kyle 1993a). Solar channels 1-9 suffered considerable degradation and, in addition, had no inflight calibration capability. No calibration corrections were developed for these channels. The SEFDT calibration algorithm for channel 10c was moderately accurate, but resulted in a noise level that at times tended to obscure true solar variations. In 1989 and 1990, a much improved channel 10c algorithm was developed (Hoyt, 1992) and all the previous data were reprocessed. These improved irradiances were not placed on the SEFDT but were released as a separate product. More details on channels 1-9 are given in Section 3.2, while channel 10c is discussed in Section 4.

3.2 Summary of Problems and Suggested Corrections

Figure 2 shows the relative changes in the measured channel 1-9 irradiances for the first 12 years of the experiment (November 1978 through November 1990). The readings are normalized by the values from day 1 (November 16, 1978). The major part of the changes arise from the sensors themselves. Identification of true solar variations requires considerable analysis at this SEFDT stage. Most of the variations shown arise from changes in the opacity of the Suprasil-W windows which cover channels (1,2 and 4-9). Outgassed vapors from the instrument and the satellite formed an obscuring film on these windows. During solar excitation maxima, the solar extreme ultraviolet radiation sharply increases and this results in a large increase in atomic oxygen at the spacecraft altitude. This tends to scour off the film so that both increases and decreases in opacity are recorded in the measurements (Predmore et al., 1982). The transmissivity increases occurred in the spring of 1979 and again in 1988 and 1989. Channel 1 was covered most of the time both in the period (1978 to 1983) and again in (1988 to 1989). When it was opened full time in 1990, its transmissivity dramatically increased. Other factors appear to have also influenced the behavior of channels 6-9 (Kyle et al., 1993b).

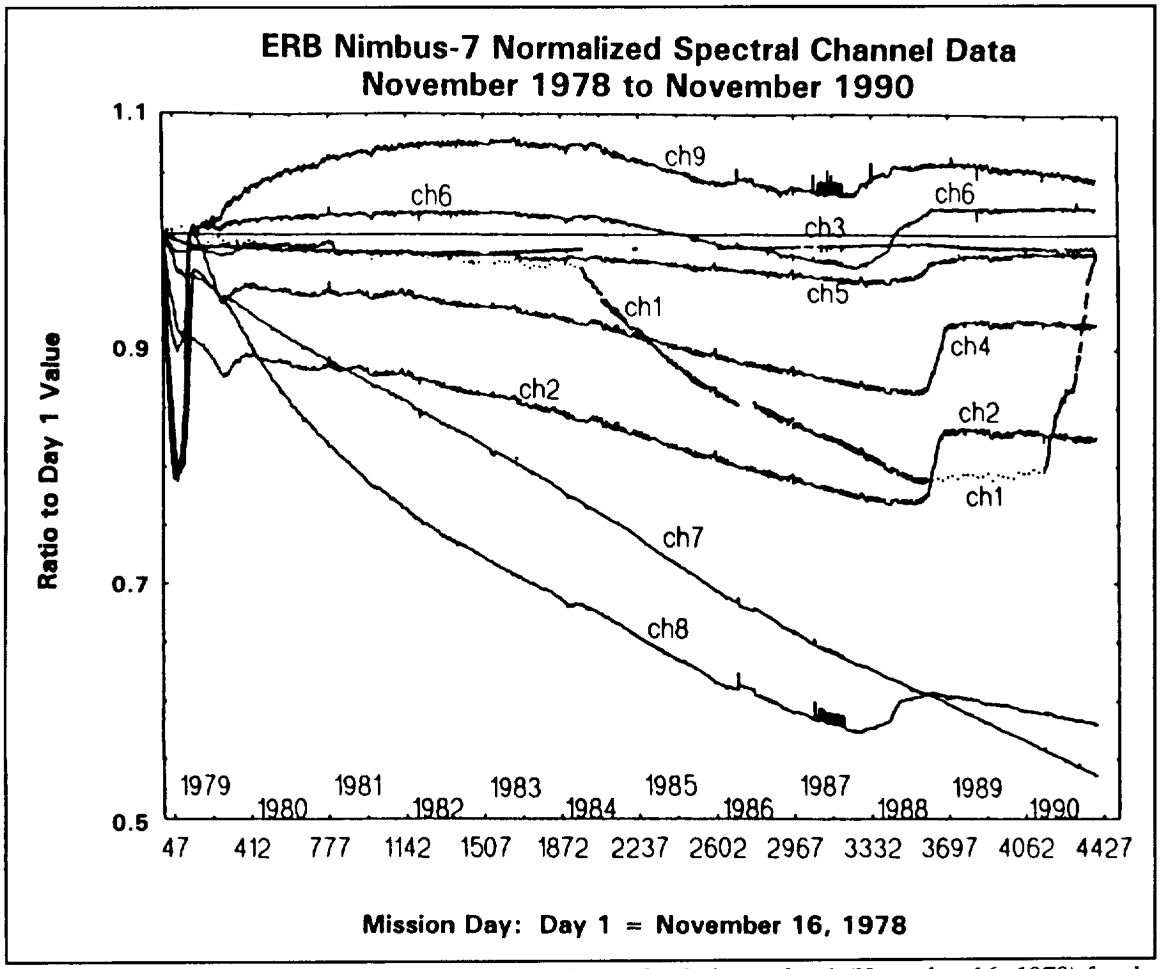

Figure 2. Changes in the responses of solar channels 1 to 9 relative to day 1 (November 16, 1978) for the period November 1978 to 1990.

Unfortunately, there is no definitive procedure to correct these opacity changes. But, solar variations over a period of a month or so have been spectrally analyzed by detrending the data for each channel (Hickey et al., 1982).

Shortly after launch, calibration coefficients were fixed for channels 1-9 and these have been used, unchanged ever since. The temperature sensitivity correction factors are given by

$$S(T) = S_V[1 + A(T - L)] \tag{1}$$

where

S_V = Channel sensitivity in a vacuum at 25°C (22°C for channel 10c only) in counts per watts/m^2 (see Table 3).

A = Temperature sensitivity at 25°C (22°C for channel 10c only) in °C^{-1} (see Table 3).

T = Temperature in °C.

L = Reference temperature: Channels 1 through 9: 25°C, Channel 10c: 22°C.

The channel sensitivity (S_V) was determined from laboratory measurements at an average temperature (L) for the calibrations (Hickey, 1985).

Table 3. Channel Coefficients

Channel	S_V	A
1	1.299	0.0007
2	1.275	0.0008
3	1.214	0.0008
4	1.719	0.0007
5	2.424	0.0006
6	6.931	0.0007
7	9.588	0.0003
8	12.715	-0.0004
9	30.170	-0.0011
10c	1.3013	0.000524

The uncorrected net solar irradiance:

$$R = [V_o - \frac{1}{2}(V_- + V_+)] / S(T) \qquad (2)$$

where

V_o = Solar channel detector output in counts at t_o, where t_o = time of minimum solar elevation (i.e., when the telescope is pointing most directly at the Sun).

V_- = Solar channel detector output in counts at t_o - 13 minutes.

V_+ = Solar channel detector output in counts at t_o + 13 minutes.

S(T) = Temperature sensitivity correction factor.

Adjustment of channel 10c for reflectance. (Note: This correction is applied to channel 10c only):

$$R_{10c} = U_{10c} * 0.998 \qquad (3)$$

U_{10c} = Unadjusted channel 10c net solar irradiance.

R_{10c} = Adjusted channel 10c net solar irradiance.

All of the irradiances are then normalized to the mean Earth flux distances. The center time (t_0) of the solar measurements is taken as the center of the local minimum in channel 5 (Figure 1). If this local minimum cannot be found, t_0 is set to the time when the southern terminator is crossed. When the channel 10c data were reprocessed, t_0 was redetermined as the time of the maximum in the channel 10c counts.

The present irradiance values on the ERB SEFDT and SST were determined using these equations. The final channel 10c irradiances were calculated using the information on the SEFDT (see Section 4). Improvements in the irradiances for channels 1-9 should include the following steps:

1. Correction for off-axis observations (see Section 2.3)

2. Improved calculation of the Earth distance. This is a relatively small correction and may not be worth while in some cases (see Section 4).

3. Detrending to correct for changes in the sensitivity. This assumes that the solar variations to be studied are of shorter duration than the stretch of data that are detrended. This detrending partially corrects for changes in the sensitivity, s, of a particular channel. Sensitivity changes are physically due to:

   - Time dependent changes in the transmissivity of the optics (very important).
   - Changes in S due to changes in the sensor chip or its cover paint (small).
   - Any changes in the filter pass bands (minor).
   - Changes in the electronics (negligible).

   The electronic changes appear negligible while the other three items cannot be evaluated to the required accuracy. Thus, detrending is recommended.

4. THE CHANNEL 10C SOLAR TAPES (CST)

This archive was designed for those wishing to study in detail the Nimbus-7 total solar irradiance measurements and their calibration. These data consist of four components. The raw irradiance counts and housekeeping data are on the CST and are discussed in Sections 4.1 and 4.2. The electric calibration is on a separate computer disk and is discussed in Section 4.3. Other PC computer disks contain the mean orbital counts and the Earth-Sun distances (Section 4.4) and the calibrated orbital radiances (Section 4.5).

4.1 The Counts Tapes

The old SEFDT calibration algorithm, for the channel 10c total solar irradiance, introduced so much noise into the final product that the relatively small physical solar signals were frequently obscured. For this reason, the present calibration equation starts with the raw counts and housekeeping data. The old SEFDT calibrated orbital irradiances are ignored. The present channel 10c counts tape, therefore, includes only the housekeeping data and the raw counts from the SEFDTs. In addition, fill values have been inserted where the Earth-Sun distance used to be. The Earth-Sun distance on the SEFDTs was an approximation which degrades the final product. As described in Section 4.4, accurate Earth-Sun distances are provided with the new calibrated orbital irradiances. The format of the channel 10c solar tape is detailed in Section 5.5.

4.2 Data Sorting and Calibration

4.2.1 Criteria for Rejecting Data as Noisy

In the final processing, the orbital and daily means were subjected to both subjective and objective screening. First a visual inspection of the data was made and values that were out-of-line were rejected from further processing. Normally only a small amount of data were rejected by this method; however, during 1987 this inspection accounted for most of the rejected data. During the special operation period, the ERB instrument was on full-time 1 day and just 30 minutes per orbit on the next. The calibration algorithm did not properly treat the 30-minute measurements and therefore, the data were rejected by inspection (see Figure 13 in Kyle et al., 1993b). Short problem periods also appeared when the ERB instrument moved from one major operation period to another. This includes the beginning and end of the 1986 special operations period. Similarly, the data are suspect just after the January 23, 1992 turn on (see Table 2). In these cases, the instrument was going through an extended warming or cooling phase and the calculated irradiances were suspect. Nonthermal problems occurred when the Sun was not in the normal measurement region of the Channel 10c field of view. This occurred at times during the γ-angle tests and in 1992 and 1993 when the Sun slowly drifted into or out of the unrestricted sensor field of view (Kyle et al., 1993b). The data from these periods, which were rejected by inspection, are included with the missing data in Table 4. Thus, some of the "missing data" are available for study, but not considered useful.

The objective screen rejected orbits when the standard deviations from the orbital mean for either the on Sun or space look was greater than three counts. These were termed bad measurements. After the orbital irradiances were calculated, a final screen was applied. It rejected those orbits that were more than two standard deviations from the daily means; over 2,000 orbits were rejected by this later criteria. Most of these were associated with nonthermal equilibrium conditions. Table 4 lists the total, missing, bad, useful, and used orbits for each year from November 16, 1978 through January 24, 1993. Recently a new screen has been added. In the new daily averages from 1990 onward, observations between 1 hour and 6 hours U.T. are now rejected as "shadowed" (see Section 4.5 and Figures 5 and 6).

4.2.2 The Channel 10c Calibration Equation

The calibration equation used to convert counts to solar total irradiance (S_o) is:

$$S_0 = \frac{k_{ref}}{k_{cal}} r^2 \frac{(C_{sun} - C_{space})}{\cos(G)} \frac{1}{[1.+A(T-22)]} \quad (4)$$

where k_{cal} is the calibration constant with a value of 1.3013 counts/Watt/meter^2, but it is assumed to have changed to 1.30168 after about orbit 45,069 on September 26, 1987. k_{ref} is a dimensionless correction constant to account for spurious reflections from the baffles into the cavity and is taken to equal 0.998 because the signal jumps up 0.2 percent as the Sun enters the unrestricted field-of-view and down by 0.2 percent as it leaves it. In between the signal behaves normally. The jumps were interpreted as due to the presence of spurious reflections. Since k_{ref} is a constant, it has no influence on the relative accuracy of the measurements. The Earth-Sun distance is r, C_{sun} is the mean on-Sun counts, C_{space} is the mean space-look counts, A ($°C^{-1}$) is the coefficient for the temperature sensitivity of the radiometer, T is the temperature of the radiometer in degrees Celsius, and G is the offset angle between the normal vector to radiometer cavity and the vector to the Sun. This equation is an attempt to remove the portions of the counts signal which arise from the instrument and geometry effects so only a pure signal arising from solar behavior remains. The equation becomes less accurate in non-thermal equilibrium conditions when the temperature (T) is changing rapidly (Smith et al., 1983).

Table 4. Summary of Useful, Bad, or Missing Orbits (1978 through January 1993)

Year	First	Last	Total	Missing	Bad	Useful	Used	Percent
1978	323	949	627	168	4	455	439	70.02
1979	950	5994	5045	1677	44	3324	3197	63.37
1980	5995	11052	5058	1385	21	3652	3513	69.45
1981	11053	16097	5045	1292	27	3726	3586	71.08
1982	16098	21142	5045	1322	13	3710	3572	70.80
1983	21143	26188	5046	916	10	4120	3980	78.87
1984	26189	31247	5059	719	9	4331	4209	83.20
1985	31248	36293	5046	27	1	5018	4861	96.33
1986	36294	41338	5045	415	0	4630	4489	88.98
1987	41339	46384	5046	1165	2	3879	3749	74.30
1988	46385	51444	5060	17	10	5033	4909	97.02
1989	51445	56490	5046	83	7	4956	4809	95.30
1990	56491	61536	5046	8	9	5029	4885	96.81
1991	61537	66584	5048	29	18	5001	4833	95.74
1992	66585	71646	5062	992	159	3911	3665	72.40
1993	71647	72075	429	33	86	310	283	66.00
Totals			71753	10248	420	61085	58979	82.20

First = first orbit number in data set for year even if data are missing
Last = last orbit number in data set for year
Total = total number of orbits in year
Missing = orbits that are missing (no measurement or visually rejected measurement; 14.28% of the orbits)
Bad = orbits that are bad, meaning the on-Sun counts have a standard deviation ≥3 counts (0.58% of the orbits)
Useful = number of orbits that may provide some useful measure of the solar irradiance. Some of these values are dropped in later analyses if they are more than 2 standard deviations away from the daily means (85.13% of the orbits)
Percent = percent of total orbits that are at present used
Used = number of orbits actually used in the final calculations of daily means (82.20% of the orbits); some 2106 values or 3.45% of the number called "useful" are discarded as being more than 2 standard deviations from the daily mean
Totals = summation of the values in the columns

The calibration equation is discussed in detail in Kyle et al., 1993b. The temperature coefficient A is assigned a constant value of 0.0003. The offset (C_{space}) is normally redetermined each year, but it is done more frequently if a major change occurs in the ERB operation mode. The offset values are given in Table 5. Finally, the offset angle G in Eq.(4) has some peculiarities. It was originally assumed that

$$G = g = \gamma - \beta - S \tag{5}$$

where g is the geometrical off-axis angle, β is the angle of the Sun relative to the Nimbus-7 orbital plane, γ is the measured angle between the axis of the solar telescope and the orbital plane, and S is a correction for any error in γ. For many years, Eq.(5) was used with S=0. Then it was discovered that the maximum response of channel 10c in the γ-plane was 2.4° off center and that the γ-angle slipped in 1980 and again in 1986. Thus, the correct value for G is

$$G = g + 2.4^\circ = (\gamma - \beta - S) + 2.4^\circ \tag{6}$$

The values for S are given in Table 6. To add to the confusion, Nimbus Operations changed the sign of the γ-angle. Thus, the user should change the sign of the γ-angle on the tape before inserting it in Eq.(6). In the fall of 1993, Nimbus Operations kept γ=-19° (their value) at all times. Further, they monitored the incoming data stream and verified that a value of -19° was returned. Somehow, on the final product tapes (MATs, SEFDT, SST, and CST) the value was entered as +20°. This error was discovered during the final calibration of the channel 10c irradiances. It was corrected for this calculation, but the main production program had then been terminated so this error remains on the main product tapes.

It is probable that in 1993 the γ-angle scale was 1.5° in error. Figure 3 shows a plot of the normalized mean on-Sun orbital counts for channel 10c versus the measured angular offset (β-γ) for September 1992. The Sun was out of view in July and August with the solar telescope pointing angle held fixed at γ=19°. At the start of September, the Sun slid back into view as its azimuth angle, β, slowly decreased. In effect, the Sun moves from right to left across the page as September advances. At β-γ=3.3°, the Sun is entirely inside the field of view, but since the measured γ is 1° off, the true off-center angle, g, is 4.3°. A similar but reverse pattern occurred in June 1992 when the Sun slid from view. This is equivalent of the Sun moving from left to right in Figure 3. But when the Sun was moving out of view in January 1993, the last clear readings occurred at β-γ=2.8°. When the Sun reappeared in October 1993, the electronics were perturbed and no transition measurements were obtained. However, the disappearance curve in December 1993 was very similar to Figure 4. The simplest explanation for this difference in Figures 3 and 4 is that the γ-angle scale slipped another half degree sometime between October 1992 and January 1993 (the γ-angle scale is discussed in Section 3 of Kyle et al., 1993b). Correction for this probable slip would make the error S, in Table 6, read 2.5° in the fall of 1993 and 1.5° in January 1993. The exact time of the slip is still to be determined. Such a correction would slightly increase the final irradiances values. No correction was made for this probable error as the project ended while the problem was being evaluated.

4.3 Electrical Calibration Data

Once every 12 days the channel 10c sensor was electrically calibrated. When the sensor was pointed at cold space, a known current and voltage was applied to the electrical heating coil wrapped around the inverted cone at the bottom of the sensor. The sensor's response to this known power input was observed allowing the calibration coefficient to be measured. Over the 16 year experiment, this procedure allowed the stability of the radiometer to be monitored (see Hoyt et al., 1992). During an individual calibration measurement, the incoming data on currents, voltages, and sensor response are multiplexed together, because of limitations on the Nimbus-7 data system. This data is recorded on the MAT tapes. Careful examination of this data indicates the calibration coefficient remained stable except for one small change in September 1987. A representative sample of the calibration data was recovered from the MAT tapes and are discussed in this section.

Table 5. Mean Radiometer Offset 13 Minutes Before a Solar Observation for Each Year

Year	Offset	Year	Offset
1978	-18.508	1986	-18.805
1979	-18.862	1986	-14.082 (special operations)
1980	-19.175 (days 1 to 202)	1987	-18.961
1980	-18.331 (days 203 to 366)	1987	-18.699 (special operations)
1981	-18.462	1988	-18.877
1982	-18.447	1989	-18.819
1983	-18.562	1990	-19.033
1984	-18.609	1991	-19.018
1985	-18.742	1992	-19.192

Table 6. Time dependent errors in the γ-angle.

Period	Error S (°)
November 16, 1978 to July 19, 1980	0.0
July 20, 1980 to June 22, 1986	0.5
June 23, 1986 to January 1993	1.0
November and December 1993 (do not change sign)	2.0

There are three ASCII files available on computer disk which contain information on the electrical calibration of channel 10c. These are the summary calibration file, the summary calibration data file, and the raw calibration data files. Each file is described, in turn, below.

The Summary Calibration Coefficients File

The summary calibration file is "calcoefs". It provides a listing of many of the electrical calibration values along with their uncertainties and supplemental data. Data from the file "caldata", described in the next subsection, are used in the derivation of the calibration file.

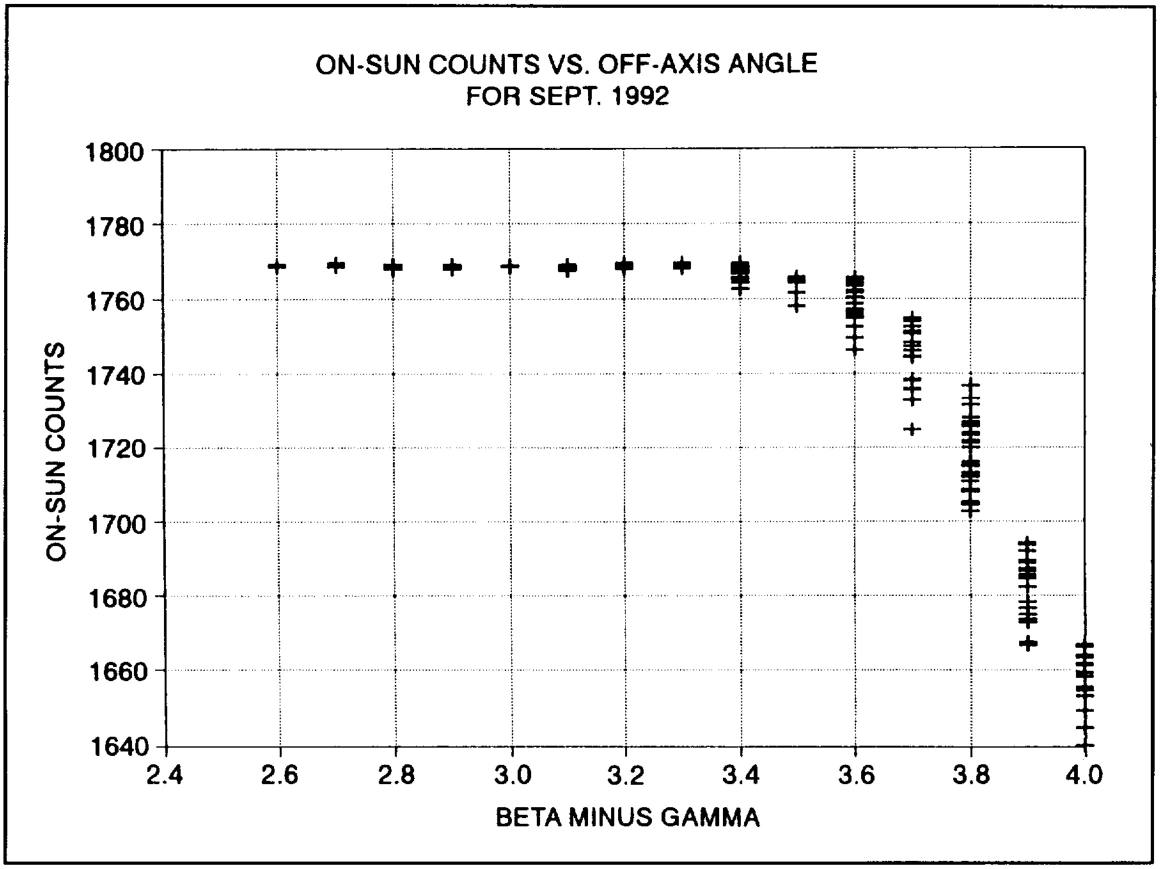

Figure 3. The Sun is shown drifting into channel 10c's clear field of view (right to left) in September 1992. The Sun was out of range in August. On the right-hand side, the Sun is partially obscured by the door of the telescope. The solar signal is given in digitized counts normalized by the square of the Earth to Sun distance. The abscissa gives the measured (not corrected) off-center angle (β-γ).

The file "calcoefs" has ten columns of data. These are:

1. The year in which the calibration was made.
2. The day of the year on which the calibration was made.
3. The orbit number for the calibration.
4. The temperature (multiplied by 10) of the radiometer baseplate in degrees Celsius during the electrical calibration.
5. The calibration coefficient in units of counts/W/m^2. This coefficient is not corrected for temperature effects in this file.
6. The one standard deviation on the calibration coefficient.
7. The current applied to the heater during the calibration, expressed in amperes.
8. The voltage applied to the heater in volts.
9. The resistance of the heater in ohms.
10. The power in milliwatts applied to the heater.

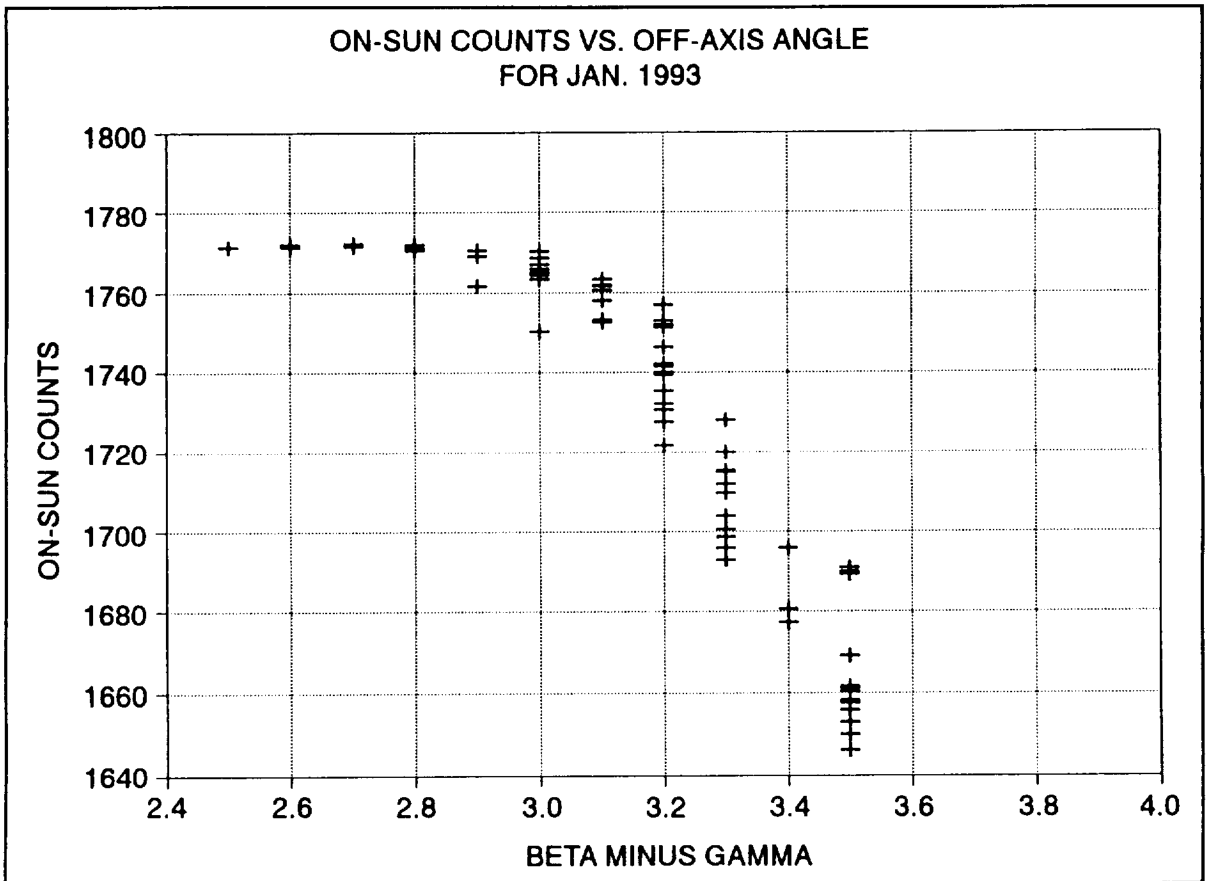

Figure 4. In January 1993, the Sun moves (left to right) out of the field of view of channel 10c (see Figure 3).

Because this file is small, a complete tabulation of the results is given in Table 7. Several equations are used to derive the quantities listed in Table 7. The equation for the calibration coefficient, CalCoef, is:

$$\text{CalCoef} = \frac{0.0500075 * (C_s - C_{s0})}{P} \tag{7}$$

where C_s is the sensor counts with the electrical power on, C_{s0} is the sensor zero offset, and P is the electrical power applied during the calibration. The power is simply the voltage times the current. The heater resistance can be found using Ohm's law, which means dividing the voltage by the current. The two equations used to find the current I and voltage V applied during the electrical calibration are:

$$I = \frac{-1.086 * 10^{-5}}{(C_I - C_{I0})} \tag{8}$$

$$V = \frac{(C_V - C_{V0})}{612.7451} \quad (9)$$

where C_I and C_V are the current and voltage counts when the electrical power is applied and C_{I0} and C_{V0} are the offset current and voltage counts.

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m²).

						Heater			
Year	Day	Orbit	Temperature (°C)*10	Calibration Coefficient	Standard Deviation	Amps	Volts	Ohms	Power
1978	320	321	196	1.302485	0.001623	0.020992	3.256516	155.13	68.360626
1978	320	322	199	1.297053	0.004481	0.020992	3.256029	155.11	68.348938
1978	342	629	213	1.299583	0.003009	0.020986	3.255001	155.11	68.308472
1978	365	946	234	1.300905	0.002365	0.020977	3.254170	155.13	68.262695
1979	60	1774	237	1.301204	0.002161	0.020977	3.254363	155.14	68.266144
1979	103	2361	162	1.296839	0.001815	0.021000	3.255463	155.02	68.363419
1979	103	2362	180	1.297905	0.002653	0.020998	3.255242	155.03	68.352097
1979	103	2364	200	1.298920	0.001786	0.020988	3.255023	155.09	68.317352
1979	103	2365	204	1.299111	0.001150	0.020988	3.255170	155.09	68.320801
1979	103	2366	207	1.299473	0.002267	0.020988	3.255004	155.09	68.315796
1979	103	2367	209	1.299236	0.001438	0.020988	3.255004	155.09	68.317047
1979	103	2368	209	1.299424	0.002359	0.020987	3.255044	155.10	68.314240
1979	103	2369	210	1.299351	0.002221	0.020988	3.254919	155.08	68.314133
1979	103	2370	211	1.299859	0.002417	0.020987	3.254986	155.09	68.313766
1979	103	2371	212	1.299500	0.001671	0.020987	3.255080	155.10	68.313766
1979	103	2372	213	1.299885	0.002389	0.020987	3.255044	155.10	68.314667
1979	103	2373	214	1.299638	0.002259	0.020987	3.254725	155.08	68.307922
1979	168	3260	223	1.300548	0.002631	0.020985	3.254932	155.11	68.305191
1979	168	3261	223	1.300461	0.002306	0.020979	3.254154	155.12	68.267273
1979	240	4255	220	1.300723	0.002141	0.020977	3.253487	155.09	68.249878
1979	288	4918	212	1.300180	0.001629	0.020978	3.253370	155.08	68.249451
1979	312	5250	217	1.300773	0.002468	0.020977	3.253328	155.09	68.246124
1980	7	6078	220	1.300397	0.001990	0.020977	3.252738	155.06	68.232880
1980	43	6577	230	1.301320	0.001991	0.020975	3.252453	155.06	68.221024
1980	103	7405	218	1.300502	0.003337	0.020977	3.252491	155.05	68.228363
1980	187	8568	230	1.300656	0.001450	0.020977	3.252195	155.03	68.221985
1980	211	8899	213	1.299863	0.001384	0.020984	3.252954	155.02	68.260895
1980	223	9065	214	1.299765	0.001954	0.020984	3.253182	155.03	68.266083

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m^2).

						Heater			
Year	Day	Orbit	Temperature (°C)*10	Calibration Coefficient	Standard Deviation	Amps	Volts	Ohms	Power
1980	283	9894	205	1.299300	0.002238	0.020987	3.252925	155.00	68.269730
1980	319	10390	200	1.299034	0.002979	0.020987	3.253144	155.01	68.273956
1981	1	11054	204	1.299312	0.001657	0.020986	3.252533	154.98	68.258453
1981	37	11551	211	1.299778	0.002593	0.020986	3.252324	154.98	68.252136
1981	109	12547	209	1.299701	0.001867	0.020987	3.252724	154.98	68.266327
1981	193	13707	212	1.299806	0.001284	0.020990	3.253391	154.99	68.289627
1981	193	13708	209	1.299652	0.002501	0.020989	3.253029	154.99	68.276993
1981	253	14537	204	1.299155	0.001510	0.020989	3.253496	155.01	68.286469
1981	325	15534	215	1.299654	0.001902	0.020986	3.252461	154.98	68.257568
1982	8	16196	217	1.299705	0.002446	0.020986	3.252952	155.01	68.265961
1982	44	16692	209	1.299351	0.001657	0.020991	3.253487	154.99	68.295120
1982	104	17523	215	1.299890	0.001920	0.020991	3.253579	155.00	68.294876
1982	188	18682	205	1.299168	0.001925	0.020991	3.253286	154.98	68.290054
1982	248	19513	209	1.298701	0.001930	0.020998	3.254022	154.97	68.327301
1982	320	20508	208	1.299062	0.001959	0.020998	3.253466	154.94	68.314789
1983	3	21172	212	1.299101	0.001989	0.020993	3.253371	154.97	68.299225
1983	39	21668	212	1.299124	0.002286	0.020998	3.253714	154.95	68.322052
1983	111	22663	208	1.299232	0.002074	0.020991	3.253242	154.98	68.289154
1983	183	23658	203	1.298779	0.001862	0.020998	3.253980	154.97	68.326767
1983	327	25650	225	1.299811	0.001534	0.020988	3.253144	155.00	68.277237
1984	10	26313	202	1.299121	0.003516	0.020996	3.253328	154.95	68.305664
1984	46	26822	237	1.300676	0.001760	0.020987	3.252651	154.99	68.262390
1984	118	27807	205	1.299113	0.001718	0.020997	3.253391	154.95	68.310013
1984	190	28803	204	1.298903	0.002269	0.020998	3.253361	154.94	68.314606
1984	190	28804	205	1.298199	0.001256	0.020999	3.253508	154.94	68.320572
1984	298	30294	194	1.298231	0.001755	0.021002	3.254283	154.95	68.347275
1985	4	31290	210	1.299504	0.002634	0.020995	3.253286	154.96	68.301544
1985	52	31963	234	1.300558	0.002514	0.020987	3.252946	155.00	68.270615
1985	112	32787	217	1.299961	0.002308	0.020989	3.253354	155.00	68.284088
1985	232	34447	218	1.299289	0.001419	0.020995	3.253503	154.96	68.307755
1985	280	35106	196	1.298540	0.001738	0.020998	3.253576	154.94	68.319962
1985	328	35771	211	1.299374	0.003526	0.020997	3.253508	154.95	68.315262
1986	23	36599	209	1.299292	0.001783	0.020997	3.253212	154.94	68.306198
1986	83	37430	217	1.299509	0.003382	0.020994	3.253317	154.96	68.300537

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m^2).									
						Heater			
Year	Day	Orbit	Temperature (°C)*10	Calibration Coefficient	Standard Deviation	Amps	Volts	Ohms	Power
1986	179	38756	204	1.298409	0.001598	0.021009	3.255172	154.94	68.386780
1986	179	38757	205	1.298049	0.001650	0.021008	3.255072	154.94	68.383621
1986	227	39421	209	1.298942	0.001816	0.021003	3.254549	154.96	68.355194
1986	275	40083	199	1.298482	0.003115	0.021006	3.254318	154.92	68.361038
1987	78	42406	212	1.299687	0.002283	0.020995	3.253328	154.96	68.303223
1987	139	43246	173	1.296877	0.001707	0.021032	3.256564	154.84	68.490860
1987	139	43247	174	1.296753	0.001924	0.021031	3.256519	154.84	68.487457
1987	199	44078	185	1.297742	0.002184	0.021011	3.255172	154.93	68.394836
1987	199	44079	186	1.297332	0.001494	0.021008	3.254932	154.94	68.379807
1987	307	45569	212	1.298712	0.002258	0.021009	3.255135	154.94	68.386429
1988	62	47228	227	1.300595	0.003469	0.020999	3.254868	155.00	68.348755
1988	157	48555	212	1.299305	0.003203	0.021001	3.254820	154.99	68.353470
1988	158	48556	216	1.299296	0.001435	0.021000	3.254521	154.97	68.346252
1989	260	55027	204	1.298645	0.002615	0.021009	3.254726	154.92	68.377792
1989	272	55192	197	1.297583	0.002056	0.021015	3.255023	154.89	68.404602
1989	284	55359	204	1.298073	0.002055	0.021017	3.254820	154.86	68.407410
1989	296	55524	204	1.298432	0.002228	0.021009	3.254697	154.92	68.377609
1989	308	55692	201	1.298617	0.003151	0.021019	3.255421	154.88	68.424332
1989	320	55856	202	1.298403	0.002092	0.021011	3.254964	154.91	68.391022
1989	332	56024	207	1.298298	0.001315	0.021012	3.255373	154.93	68.400497
1989	344	56187	208	1.298530	0.002835	0.021009	3.255146	154.94	68.388275
1989	356	56355	211	1.298604	0.001246	0.021010	3.255170	154.93	68.392624
1990	3	56520	212	1.298732	0.002497	0.021010	3.255135	154.94	68.388870
1990	63	57350	217	1.298666	0.001379	0.021010	3.255212	154.94	68.391312
1990	75	57517	214	1.299055	0.001697	0.021010	3.255309	154.94	68.392563
1990	87	57685	212	1.298831	0.001496	0.021010	3.255170	154.93	68.391373
1990	99	57851	211	1.298732	0.001668	0.021009	3.255097	154.94	68.387619
1990	111	58015	211	1.298893	0.001973	0.021009	3.254824	154.92	68.381897
1990	123	58180	209	1.298769	0.002234	0.021010	3.255227	154.94	68.391617
1990	135	58352	209	1.298563	0.001434	0.021011	3.255232	154.93	68.394775
1990	147	58513	212	1.298765	0.001542	0.021010	3.255350	154.94	68.394958
1990	159	58683	209	1.298880	0.001940	0.021010	3.254616	154.91	68.379272
1990	159	58684	210	1.298678	0.001226	0.021008	3.255431	154.96	68.388687
1990	171	58849	208	1.298575	0.001520	0.021012	3.255295	154.93	68.400253

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m^2).									
						Heater			
Year	Day	Orbit	Temperature (°C)*10	Calibration Coefficient	Standard Deviation	Amps	Volts	Ohms	Power
1990	171	58850	209	1.298666	0.002153	0.021009	3.255295	154.95	68.389343
1990	183	59015	209	1.298489	0.001551	0.021013	3.255785	154.94	68.414978
1990	183	59016	209	1.298762	0.001691	0.021010	3.254860	154.92	68.384277
1990	195	59173	207	1.298422	0.001781	0.021013	3.255547	154.93	68.409134
1990	195	59174	208	1.298749	0.003576	0.021010	3.255139	154.93	68.391968
1990	207	59341	208	1.298680	0.001860	0.021009	3.255379	154.95	68.393402
1990	207	59342	209	1.298438	0.000651	0.021014	3.255023	154.90	68.401337
1990	219	59506	207	1.298543	0.001314	0.021011	3.255309	154.94	68.395844
1990	231	59681	207	1.298706	0.003024	0.021010	3.255218	154.94	68.391739
1990	243	59839	208	1.298737	0.001636	0.021009	3.255146	154.94	68.388519
1990	255	60006	209	1.298824	0.001879	0.021009	3.254715	154.92	68.378799
1990	267	60172	207	1.298536	0.001485	0.021010	3.255379	154.94	68.395187
1990	279	60340	207	1.298271	0.002224	0.021009	3.255309	154.95	68.391251
1990	291	60506	205	1.298417	0.002618	0.021011	3.255295	154.94	68.395554
1990	303	60670	205	1.298441	0.001469	0.021010	3.255460	154.95	68.397339
1990	315	60838	208	1.298718	0.001976	0.021009	3.255041	154.93	68.385651
1990	327	61002	209	1.298715	0.002510	0.021010	3.255337	154.94	68.393402
1990	339	61165	209	1.298487	0.001311	0.021010	3.255460	154.95	68.397873
1990	351	61334	215	1.298541	0.002757	0.021010	3.255953	154.97	68.406693
1990	363	61501	217	1.299620	0.003563	0.021009	3.253762	154.88	68.357162
1991	34	61998	222	1.298962	0.002192	0.021007	3.255064	154.95	68.378616
1991	58	62329	224	1.299020	0.001708	0.021006	3.255170	154.97	68.376480
1991	70	62494	221	1.298837	0.001890	0.021008	3.255468	154.96	68.391373
1991	82	62661	217	1.298898	0.001637	0.021009	3.254982	154.93	68.384048
1991	94	62830	213	1.298779	0.001606	0.021009	3.255060	154.94	68.386078
1991	106	62993	212	1.298859	0.001869	0.021010	3.255282	154.94	68.392334
1991	118	63163	209	1.298689	0.001987	0.021010	3.255839	154.97	68.404846
1991	130	63327	209	1.298283	0.002155	0.021016	3.256166	154.94	68.430298
1991	142	63491	211	1.298462	0.002361	0.021016	3.256395	154.95	68.435120
1991	166	63823	209	1.298558	0.001712	0.021011	3.255944	154.96	68.410446
1991	166	63824	209	1.298667	0.001824	0.021011	3.254932	154.92	68.389282
1991	178	63991	209	1.298296	0.001649	0.021013	3.256202	154.96	68.421661
1991	178	63992	209	1.298384	0.001410	0.021012	3.255622	154.94	68.406815
1991	190	64154	208	1.298451	0.002439	0.021016	3.255737	154.92	68.422073

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m²).									
						Heater			
Year	Day	Orbit	Temperature (°C)*10	Calibration Coefficient	Standard Deviation	Amps	Volts	Ohms	Power
1991	190	64155	209	1.298215	0.001810	0.021015	3.255658	154.92	68.418610
1991	202	64320	212	1.298594	0.002109	0.021012	3.255797	154.95	68.410324
1991	214	64485	209	1.298460	0.003588	0.021013	3.255561	154.93	68.407822
1991	226	64655	212	1.298569	0.002285	0.021012	3.255881	154.95	68.413910
1991	238	64819	212	1.298682	0.002193	0.021013	3.255549	154.93	68.409973
1991	250	64986	212	1.298554	0.002168	0.021012	3.255763	154.95	68.408661
1991	262	65153	290	1.298354	0.002850	0.021016	3.256132	154.93	68.431198
1991	274	65317	211	1.298584	0.001534	0.021009	3.255379	154.95	68.393646
1991	286	65484	215	1.298727	0.002203	0.021014	3.255512	154.92	68.410812
1991	298	65649	212	1.298459	0.001775	0.021013	3.255839	154.94	68.416046
1991	310	65816	214	1.298676	0.002100	0.021010	3.255588	154.96	68.399063
1991	322	65982	215	1.298860	0.001875	0.021010	3.255282	154.94	68.394714
1991	334	66150	219	1.299208	0.002027	0.021010	3.255157	154.94	68.390182
1991	358	66481	222	1.299035	0.002027	0.021009	3.254986	154.93	68.384109
1992	29	66978	228	1.299580	0.002791	0.021010	3.255431	154.95	68.396744
1992	53	67310	224	1.299410	0.001384	0.021010	3.255463	154.95	68.395782
1992	77	67641	223	1.299368	0.001646	0.021011	3.255460	154.94	68.399002
1992	125	68305	214	1.298582	0.001819	0.021018	3.256132	154.92	68.436432
1992	137	68469	214	1.298761	0.003292	0.021017	3.256084	154.93	68.431854
1992	185	69137	212	1.298730	0.001433	0.021016	3.256111	154.93	68.430588
1992	185	69138	213	1.298656	0.001925	0.021013	3.255268	154.91	68.404541
1992	269	70301	216	1.298806	0.001849	0.021016	3.255839	154.92	68.425583
1992	281	70463	219	1.298784	0.001989	0.021016	3.255920	154.92	68.427734
1992	293	70629	222	1.298728	0.001490	0.021015	3.256258	154.95	68.430710
1992	305	70793	220	1.298755	0.001693	0.021014	3.256090	154.95	68.422913
1992	329	71126	225	1.298984	0.002222	0.021013	3.255880	154.94	68.416763
1993	286	75590	222	1.297641	0.002955	0.021029	3.257848	154.92	68.508743
1993	321	76077	231	1.297957	0.001653	0.021031	3.257583	154.90	68.509399
1993	357	76574	237	1.299481	0.001779	0.021010	3.255991	154.97	68.409607

The Summary Calibration Counts Data File

The summary calibration data file, "caldata", gives the mean raw count values used to derive the values in "calcoefs". This file is a summary of the raw calibration data file. It consists of thirteen columns of data. They are:

1. The year in which the calibration was made.
2. The day of the year on which the calibration was made.
3. The orbit number for the calibration.
4. The temperature (multiplied by 10) of the radiometer baseplate in degrees Celsius during the electrical calibration.
5. The average thermopile counts.
6. The one standard deviation uncertainty of the average thermopile counts.
7. The average heater current counts.
8. The one standard deviation uncertainty of the average heater current counts.
9. The average heater voltage counts.
10. The one standard deviation uncertainty of the average heater voltage counts.
11. The thermopile count offset.
12. The heater current count offset.
13. The heater voltage count offset.

Because this file is small, a complete tabulation of the results is given in Table 8.

The Raw Calibration Data Files

The raw calibration data files consist of individual files for each year and are labelled year78.cal, year79.cal, and so forth to year93.cal. Each file has eleven columns of data. They are:

1. The year in which the calibration was made.
2. The day of the year on which the calibration was made.
3. The orbit number for the calibration.
4. The temperature (multiplied by 10) of the radiometer baseplate in degrees Celsius during the electrical calibration.
5. The average thermopile counts.
6. The average heater current counts.
7. The average heater voltage counts.
8. The thermopile count offset.
9. The heater current count offset.
10. The heater voltage count offset.
11. The status switch. Values greater than 2000 indicate an electrical calibration is being performed.

Each line of data represent one sample made during the electrical calibration. The incoming data, listed on the MAT, is multiplexed together. Here, the data are separated in such a way that one count value (i.e., voltage, current, or thermopile response or offset) is placed on each line of data and the other data is set to zero since they are not sampled at that moment. This procedure simply makes subsequent programming easier. Since these data are summarized in Table 8, no additional sample is given here.

Table 8. Counts Values During Calibrations												
				Thermopile		Heater Current		Heater Voltage		Offsets		
Year	Day	Orbit	Temperature (°C)*10	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Thermal	Amps	Volts
1978	320	321	196	1762.00	0.00	-1926.96	1.10	1960.41	1.35	-18.51	6.00	-35.00
1978	320	322	199	1754.27	1.31	-1926.92	1.12	1960.12	1.70	-18.51	6.00	-35.00
1978	342	629	213	1756.19	0.71	-1926.39	1.11	1959.49	1.37	-19.00	6.00	-35.00
1978	365	946	234	1756.80	0.66	-1925.58	0.91	1958.98	1.21	-19.00	6.00	-35.00
1979	60	1774	237	1757.44	1.02	-1925.57	0.95	1959.10	1.19	-18.86	6.00	-35.00
1979	103	2361	162	1754.00	0.00	-1927.67	0.90	1959.77	1.16	-18.86	6.00	-35.00
1979	103	2362	180	1755.03	0.16	-1927.48	1.09	1959.63	1.04	-19.00	6.00	-35.00
1979	103	2364	200	1755.65	0.48	-1926.62	1.15	1959.50	1.01	-18.86	6.00	-35.00
1979	103	2365	204	1756.00	0.00	-1926.63	0.83	1959.59	0.91	-18.86	6.00	-35.00
1979	103	2366	207	1756.22	1.27	-1926.59	0.92	1959.49	1.10	-19.00	6.00	-35.00
1979	103	2367	209	1756.07	0.26	-1926.63	0.87	1959.49	1.01	-18.86	6.00	-35.00
1979	103	2368	209	1756.26	1.29	-1926.52	1.06	1959.51	1.07	-18.86	6.00	-35.00
1979	103	2369	210	1756.15	0.37	-1926.60	0.89	1959.44	1.10	-18.86	6.00	-35.00
1979	103	2370	211	1756.70	1.44	-1926.55	0.98	1959.48	1.09	-19.00	6.00	-35.00
1979	103	2371	212	1756.35	0.48	-1926.49	1.05	1959.53	0.93	-18.86	6.00	-35.00
1979	103	2372	213	1756.90	1.41	-1926.54	0.98	1959.51	1.07	-18.86	6.00	-35.00
1979	103	2373	214	1756.38	0.49	-1926.53	0.96	1959.32	1.19	-18.86	6.00	-35.00
1979	168	3260	223	1757.56	1.67	-1926.33	1.00	1959.44	1.13	-18.86	6.00	-35.00
1979	168	3261	223	1756.45	0.51	-1925.72	1.03	1958.97	1.20	-18.86	6.00	-35.00
1979	240	4255	220	1756.36	1.27	-1925.63	0.87	1958.56	0.96	-18.86	6.00	-35.00
1979	288	4918	212	1755.61	0.50	-1925.68	0.84	1958.49	1.07	-18.86	6.00	-35.00
1979	312	5250	217	1756.19	1.51	-1925.62	0.96	1958.46	1.10	-19.00	6.00	-35.00
1980	7	6078	220	1756.00	0.23	-1925.59	0.97	1958.10	1.28	-18.33	6.00	-35.00
1980	43	6577	230	1756.28	0.72	-1925.42	1.13	1957.92	1.07	-19.00	6.00	-35.00
1980	103	7405	218	1756.03	0.16	-1925.61	1.02	1957.95	1.23	-18.33	6.00	-35.00
1980	187	8568	230	1756.07	0.26	-1925.60	0.90	1957.77	1.00	-18.33	6.00	-35.00
1980	211	8899	213	1756.00	0.00	-1926.26	1.03	1958.23	1.07	-18.33	6.00	-35.00
1980	223	9065	214	1756.00	0.00	-1926.27	1.01	1958.37	1.11	-18.33	6.00	-35.00
1980	283	9894	205	1755.46	0.51	-1926.52	1.00	1958.21	1.33	-18.33	6.00	-35.00
1980	319	10390	200	1755.08	0.48	-1926.51	0.98	1958.35	1.11	-18.46	6.00	-35.00
1981	1	11054	204	1755.05	0.23	-1926.44	1.10	1957.97	1.16	-18.46	6.00	-35.00
1981	37	11551	211	1755.52	0.64	-1926.38	1.13	1957.85	1.06	-18.46	6.00	-35.00
1981	109	12547	209	1755.25	0.59	-1926.55	0.98	1958.09	1.20	-19.00	6.00	-35.00
1981	193	13707	212	1756.00	0.00	-1926.81	0.93	1958.50	1.01	-19.00	6.00	-35.00
1981	193	13708	209	1756.00	0.00	-1926.67	0.91	1958.28	1.32	-18.46	6.00	-35.00

Table 8. Counts Values During Calibrations												
				Thermopile		Heater Current		Heater Voltage		Offsets		
Year	Day	Orbit	Temperature (°C)*10	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Thermal	Amps	Volts
1981	253	14537	204	1755.57	0.50	-1926.66	0.81	1958.56	0.91	-18.46	6.00	-35.00
1981	325	15534	215	1755.51	0.51	-1926.45	1.11	1957.93	1.20	-18.45	6.00	-35.00
1982	8	16196	217	1755.80	0.82	-1926.40	1.15	1958.23	1.06	-18.45	6.00	-35.00
1982	44	16692	209	1756.07	0.47	-1926.91	1.02	1958.56	0.96	-18.45	6.00	-35.00
1982	104	17523	215	1756.25	0.44	-1926.85	0.93	1958.62	0.99	-19.00	6.00	-35.00
1982	188	18682	205	1755.69	0.47	-1926.88	1.00	1958.44	1.39	-18.45	6.00	-35.00
1982	248	19513	209	1756.02	0.15	-1927.50	0.95	1958.89	1.10	-18.45	6.00	-35.00
1982	320	20508	208	1756.07	0.83	-1927.48	1.02	1958.55	1.02	-18.56	6.00	-35.00
1983	3	21172	212	1755.72	0.85	-1927.09	1.06	1958.49	1.00	-18.56	6.00	-35.00
1983	39	21668	212	1756.35	0.48	-1927.53	0.96	1958.70	0.94	-18.56	6.00	-35.00
1983	111	22663	208	1755.64	0.48	-1926.88	1.05	1958.41	1.11	-18.56	6.00	-35.00
1983	183	23658	203	1756.00	0.00	-1927.51	1.04	1958.86	1.08	-18.56	6.00	-35.00
1983	327	25650	225	1756.08	0.27	-1926.60	0.85	1958.35	1.17	-18.61	6.00	-35.00
1984	10	26313	202	1755.87	0.95	-1927.30	1.11	1958.46	1.10	-18.61	6.00	-35.00
1984	46	26822	237	1756.87	0.34	-1926.48	1.09	1958.05	1.19	-18.61	6.00	-35.00
1984	118	27807	205	1755.97	0.16	-1927.39	1.08	1958.50	1.34	-18.61	6.00	-35.00
1984	190	28803	204	1755.81	0.40	-1927.53	0.94	1958.48	2.06	-18.61	6.00	-35.00
1984	190	28804	205	1755.00	0.00	-1927.62	0.96	1958.57	0.94	-18.61	6.00	-35.00
1984	298	30294	194	1755.60	0.49	-1927.91	1.02	1959.05	1.09	-18.74	6.00	-35.00
1985	4	31290	210	1755.90	0.31	-1927.21	1.01	1958.44	1.35	-19.00	6.00	-35.00
1985	52	31963	234	1756.79	0.41	-1926.53	0.96	1958.23	1.51	-18.74	6.00	-35.00
1985	112	32787	217	1756.07	0.45	-1926.67	0.97	1958.48	1.11	-19.00	6.00	-35.00
1985	232	34447	218	1756.02	0.15	-1927.26	1.05	1958.57	0.93	-18.74	6.00	-35.00
1985	280	35106	196	1755.32	0.61	-1927.56	0.96	1958.61	0.99	-18.74	6.00	-35.00
1985	328	35771	211	1756.07	0.47	-1927.47	0.98	1958.57	0.99	-19.00	6.00	-35.00
1986	23	36599	209	1755.92	0.27	-1927.38	0.99	1958.39	1.41	-18.80	6.00	-35.00
1986	83	37430	217	1756.07	0.47	-1927.16	0.95	1958.45	1.11	-18.80	6.00	-35.00
1986	179	38756	204	1756.81	0.40	-1928.50	1.01	1959.59	0.96	-18.80	6.00	-35.00
1986	179	38757	205	1756.24	0.44	-1928.47	1.07	1959.53	0.94	-18.80	6.00	-35.00
1986	227	39421	209	1756.72	0.46	-1927.98	1.00	1959.21	1.25	-18.80	6.00	-35.00
1986	275	40083	199	1756.05	0.21	-1928.28	0.98	1959.07	1.23	-19.00	6.00	-35.00
1987	78	42406	212	1756.23	1.29	-1927.23	0.93	1958.46	1.10	-18.96	6.00	-35.00
1987	139	43246	173	1757.26	0.44	-1930.62	1.04	1960.44	1.05	-18.96	6.00	-35.00
1987	139	43247	174	1757.00	0.00	-1930.55	1.04	1960.42	1.16	-18.96	6.00	-35.00
1987	199	44078	185	1755.95	1.28	-1928.73	0.94	1959.59	0.96	-18.96	6.00	-35.00

Table 8. Counts Values During Calibrations

				Thermopile		Heater Current		Heater Voltage		Offsets		
Year	Day	Orbit	Temperature (°C)*10	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Thermal	Amps	Volts
1987	199	44079	186	1755.00	0.00	-1928.44	1.13	1959.44	1.13	-18.96	6.00	-35.00
1987	307	45569	212	1757.14	0.65	-1928.51	0.98	1959.57	1.00	-18.88	6.00	-35.00
1988	62	47228	227	1757.62	0.49	-1927.60	0.88	1959.40	0.99	-20.00	6.00	-35.00
1988	157	48555	212	1756.97	0.16	-1927.77	0.87	1959.37	1.08	-19.00	6.00	-35.00
1988	158	48556	216	1756.96	0.21	-1927.74	0.81	1959.19	1.13	-18.82	6.00	-35.00
1989	260	55027	204	1756.70	0.46	-1928.51	1.04	1959.32	1.72	-19.00	6.00	-35.00
1989	272	55192	197	1756.13	0.34	-1929.09	1.04	1959.50	1.70	-18.82	6.00	-35.00
1989	284	55359	204	1756.87	0.34	-1929.29	1.05	1959.37	1.69	-18.82	6.00	-35.00
1989	296	55524	204	1756.59	0.50	-1928.52	0.98	1959.30	1.86	-18.82	6.00	-35.00
1989	308	55692	201	1757.12	0.79	-1929.41	1.12	1959.74	1.02	-19.75	6.00	-35.00
1989	320	55856	202	1756.90	0.31	-1928.74	0.95	1959.46	1.89	-18.82	6.00	-35.00
1989	332	56024	207	1757.00	0.00	-1928.77	1.02	1959.71	0.97	-18.82	6.00	-35.00
1989	344	56187	208	1757.00	0.00	-1928.56	0.98	1959.57	1.03	-18.82	6.00	-35.00
1989	356	56355	211	1757.00	0.00	-1928.67	0.87	1959.59	1.02	-19.03	6.00	-35.00
1990	3	56520	212	1757.08	0.48	-1928.58	0.91	1959.57	0.93	-19.03	6.00	-35.00
1990	63	57350	217	1757.05	0.22	-1928.60	0.90	1959.62	0.94	-19.03	6.00	-35.00
1990	75	57517	214	1757.62	0.49	-1928.58	0.91	1959.67	1.12	-19.03	6.00	-35.00
1990	87	57685	212	1757.28	0.45	-1928.63	0.85	1959.59	0.91	-19.03	6.00	-35.00
1990	99	57851	211	1757.05	0.21	-1928.57	0.93	1959.55	1.37	-19.03	6.00	-35.00
1990	111	58015	211	1757.15	0.36	-1928.57	0.93	1959.38	1.67	-19.00	6.00	-35.00
1990	123	58180	209	1757.20	1.26	-1928.60	0.90	1959.62	1.08	-19.03	6.00	-35.00
1990	135	58352	209	1757.00	0.00	-1928.69	0.78	1959.63	0.95	-19.03	6.00	-35.00
1990	147	58513	212	1757.28	0.46	-1928.62	0.84	1959.70	0.99	-19.03	6.00	-35.00
1990	159	58683	209	1757.03	0.17	-1928.62	0.85	1959.25	1.90	-19.03	6.00	-35.00
1990	159	58684	210	1757.00	0.00	-1928.40	1.34	1959.75	0.50	-19.03	6.00	-35.00
1990	171	58849	208	1757.19	0.40	-1928.81	0.75	1959.67	1.11	-19.00	6.00	-35.00
1990	171	58850	209	1757.00	0.00	-1928.50	1.04	1959.67	0.82	-19.03	6.00	-35.00
1990	183	59015	209	1757.42	0.50	-1928.93	0.83	1959.97	0.96	-19.03	6.00	-35.00
1990	183	59016	209	1757.00	0.00	-1928.62	0.77	1959.40	1.07	-19.03	6.00	-35.00
1990	195	59173	207	1757.18	0.56	-1928.91	1.01	1959.82	1.07	-19.03	6.00	-35.00
1990	195	59174	208	1757.18	0.66	-1928.67	1.02	1959.57	0.87	-19.03	6.00	-35.00
1990	207	59341	208	1757.12	0.79	-1928.56	0.94	1959.72	1.00	-19.03	6.00	-35.00
1990	207	59342	209	1757.00	0.00	-1929.00	0.00	1959.50	1.00	-19.03	6.00	-35.00
1990	219	59506	207	1757.00	0.00	-1928.67	0.92	1959.67	1.07	-19.03	6.00	-35.00
1990	231	59681	207	1757.15	0.95	-1928.61	0.92	1959.62	1.10	-19.00	6.00	-35.00

Table 8. Counts Values During Calibrations

				Thermopile		Heater Current		Heater Voltage		Offsets		
Year	Day	Orbit	Temperature (°C)*10	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Thermal	Amps	Volts
1990	243	59839	208	1757.07	0.47	-1928.56	0.94	1959.57	1.01	-19.03	6.00	-35.00
1990	255	60006	209	1756.98	0.16	-1928.55	0.93	1959.31	1.76	-19.00	6.00	-35.00
1990	267	60172	207	1756.97	0.16	-1928.62	1.04	1959.72	1.02	-19.03	6.00	-35.00
1990	279	60340	207	1756.51	1.21	-1928.55	1.02	1959.67	1.02	-19.03	6.00	-35.00
1990	291	60506	205	1756.82	0.39	-1928.67	0.94	1959.67	1.08	-19.03	6.00	-35.00
1990	303	60670	205	1756.90	0.30	-1928.63	0.85	1959.77	1.04	-19.03	6.00	-35.00
1990	315	60838	208	1756.98	0.16	-1928.55	1.00	1959.51	1.83	-19.03	6.00	-35.00
1990	327	61002	209	1757.21	1.28	-1928.59	0.91	1959.69	0.98	-19.00	6.00	-35.00
1990	339	61165	209	1756.98	0.15	-1928.64	0.82	1959.77	1.00	-19.03	6.00	-35.00
1990	351	61334	215	1757.28	0.70	-1928.60	0.89	1960.07	0.96	-19.03	6.00	-35.00
1990	363	61501	217	1757.00	0.00	-1928.50	1.00	1958.73	3.04	-19.50	6.00	-35.00
1991	34	61998	222	1757.12	0.52	-1928.33	1.06	1959.52	0.99	-19.03	6.00	-35.00
1991	58	62329	224	1757.15	0.66	-1928.21	0.94	1959.59	0.91	-19.03	6.00	-35.00
1991	70	62494	221	1757.29	0.71	-1928.45	1.09	1959.77	0.99	-19.03	6.00	-35.00
1991	82	62661	217	1757.18	0.39	-1928.53	0.98	1959.47	1.06	-19.03	6.00	-35.00
1991	94	62830	213	1757.07	0.26	-1928.55	0.98	1959.52	1.17	-19.03	6.00	-35.00
1991	106	62993	212	1757.34	0.48	-1928.59	0.92	1959.66	1.38	-19.03	6.00	-35.00
1991	118	63163	209	1757.47	0.73	-1928.61	1.15	1960.00	1.06	-19.00	6.00	-35.00
1991	130	63327	209	1757.54	0.51	-1929.14	1.04	1960.20	1.16	-19.03	6.00	-35.00
1991	142	63491	211	1757.91	0.88	-1929.14	0.97	1960.34	1.14	-19.03	6.00	-35.00
1991	166	63823	209	1757.40	0.50	-1928.71	0.86	1960.06	1.18	-19.03	6.00	-35.00
1991	166	63824	209	1757.00	0.00	-1928.71	1.25	1959.44	1.51	-19.03	6.00	-35.00
1991	178	63991	209	1757.33	0.52	-1928.87	0.83	1960.22	1.09	-19.03	6.00	-35.00
1991	178	63992	209	1757.07	0.25	-1928.80	0.85	1959.87	1.01	-19.03	6.00	-35.00
1991	190	64154	208	1757.56	0.51	-1929.16	1.10	1959.94	2.05	-19.03	6.00	-35.00
1991	190	64155	209	1757.14	0.38	-1929.11	1.05	1959.89	1.27	-19.03	6.00	-35.00
1991	202	64320	212	1757.45	0.50	-1928.79	0.98	1959.97	1.09	-19.03	6.00	-35.00
1991	214	64485	209	1757.23	0.43	-1928.86	1.05	1959.83	1.22	-19.00	6.00	-35.00
1991	226	64655	212	1757.54	0.51	-1928.85	0.99	1960.03	1.48	-19.00	6.00	-35.00
1991	238	64819	212	1757.56	0.50	-1928.93	0.95	1959.82	1.83	-19.03	6.00	-35.00
1991	250	64986	212	1757.35	1.25	-1928.77	0.92	1959.95	0.97	-19.03	6.00	-35.00
1991	262	65153	290	1757.69	0.47	-1929.19	1.01	1960.18	1.25	-19.00	6.00	-35.00
1991	274	65317	211	1757.00	0.00	-1928.57	0.91	1959.72	1.41	-19.03	6.00	-35.00
1991	286	65484	215	1757.64	0.49	-1928.98	0.94	1959.80	1.87	-19.03	6.00	-35.00
1991	298	65649	212	1757.41	0.50	-1928.93	1.00	1960.00	1.14	-19.03	6.00	-35.00

Table 8. Counts Values During Calibrations												
				Thermopile		Heater Current		Heater Voltage		Offsets		
Year	Day	Orbit	Temperature (°C)*10	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Thermal	Amps	Volts
1991	310	65816	214	1757.30	0.46	-1928.60	0.96	1959.85	1.01	-19.00	6.00	-35.00
1991	322	65982	215	1757.40	0.50	-1928.66	0.91	1959.66	1.38	-19.03	6.00	-35.00
1991	334	66150	219	1757.79	0.41	-1928.60	0.90	1959.58	1.72	-19.00	6.00	-35.00
1991	358	66481	222	1757.21	0.94	-1928.53	0.96	1959.48	1.07	-19.19	6.00	-35.00
1992	29	66978	228	1758.28	0.72	-1928.63	0.87	1959.75	1.01	-19.19	6.00	-35.00
1992	53	67310	224	1758.03	0.16	-1928.58	0.88	1959.77	1.04	-19.19	6.00	-35.00
1992	77	67641	223	1758.05	0.22	-1928.67	0.84	1959.77	1.41	-19.19	6.00	-35.00
1992	125	68305	214	1757.95	0.22	-1929.33	0.98	1960.18	0.97	-19.19	6.00	-35.00
1992	137	68469	214	1758.07	0.66	-1929.23	1.02	1960.15	1.05	-19.19	6.00	-35.00
1992	185	69137	212	1758.00	0.00	-1929.18	1.18	1960.17	0.99	-19.19	6.00	-35.00
1992	185	69138	213	1757.22	0.43	-1928.94	0.94	1959.65	0.93	-19.19	6.00	-35.00
1992	269	70301	216	1757.97	0.16	-1929.20	1.09	1960.00	1.54	-19.19	6.00	-35.00
1992	281	70463	219	1758.00	0.00	-1929.21	1.18	1960.05	1.84	-19.19	6.00	-35.00
1992	293	70629	222	1758.00	0.00	-1929.10	1.14	1960.26	1.12	-19.19	6.00	-35.00
1992	305	70793	220	1758.03	0.16	-1928.98	0.84	1960.15	1.04	-19.00	6.00	-35.00
1992	329	71126	225	1758.18	0.39	-1928.93	1.08	1960.02	1.86	-19.00	6.00	-35.00
1993	286	10054	222	1758.87	0.34	-1930.36	0.96	1961.23	1.13	-18.86	6.00	-35.00
1993	321	10541	231	1759.18	0.39	-1930.53	0.91	1961.07	1.17	-19.00	6.00	-35.00
1993	357	11038	237	1758.67	0.62	-1928.66	0.86	1960.09	1.15	-19.00	6.00	-35.00

4.4 Orbital Mean Counts and Earth-Sun Distances

There are 16 files on floppy disks containing mean channel 10c on-Sun counts and ancillary data. These files are labelled as year78.dat to year93.dat, where the two digits designate the year from 1978 to 1993. They occupy about 5.1 Megabytes of disk space and contain data for 62,031 orbits. Some observational data from the channel 10c counts tapes were rejected as being obviously noisy.

Each file has one line of data for each orbit. There are 18 columns of data. The data columns are:

1. Year of observation
2. Day of year
3. Hour (UT)
4. Minute (UT)
5. Second (UT)
6. The orbit number of the observation.
7. The Earth-Sun distance in astronomical units calculated using the JPL Ephemeris tape.
8. The beta angle (degrees * 10)
9. The gamma angle (degrees * 10) from CST and SEFDT except for the fall of 1993

10. The spacelook counts times 100 taken 13 minutes before the sun enters the field of view of the radiometer. 32 one second observations are used to calculate this value. It is abbreviated as a T-13 observation.

11. The maximum on-Sun counts times 100, calculated from the mean of 42 one second observations. It is abbreviated as a T observation.

12. The spacelook counts times 100 taken 13 minutes after the sun has entered the field of view of the radiometer. 32 one second observations are used to calculate this value. It is abbreviated as a T+13 observation.

13. The standard deviation times 100 of the T-13 observation.

14. The standard deviation times 100 of the T observation.

15. The standard deviation times 100 of the T+13 observation.

16. The temperature of the radiometer baseplate during the T-13 observation. It is an average of two measurements.

17. The temperature of the radiometer baseplate during the T observation. It is an average of two measurements.

18. The temperature of the radiometer baseplate during the T+13 observation. It is an average of two measurements.

A sample of a typical data file is listed in Table 9.

Table 9. Sample of the format in the year**.dat file using year90.dat.

							Counts x 10			Standard Deviation			Tp (°C)*10		
Year	Day	HHMMSS	Orbit	AU	β	γ	T-13	T	T+13	-13	0	+13	-13	0	+13
1990	1	14956	56492	.9833348	74	-70	-1900	183100	-1600	0	22	0	206	207	216
1990	1	33427	56493	.9833336	71	-70	-1900	183069	-1600	0	46	0	206	207	217
1990	1	51811	56494	.9833324	73	-70	-1900	183104	-1600	0	22	0	206	207	217
1990	1	70243	56495	.9833312	73	-70	-1900	183087	-1600	0	33	0	207	209	217
1990	1	84627	56496	.9833301	74	-70	-1900	183152	-1600	0	50	0	207	209	218
1990	1	103043	56497	.9833290	74	-70	-1900	183147	-1600	0	50	0	209	210	220
1990	1	121459	56498	.9833279	72	-70	-1900	183147	-1600	0	50	0	209	210	220
1990	1	135859	56499	.9833268	74	-70	-1903	183150	-1600	17	50	0	209	209	219
1990	1	154315	56500	.9833257	73	-70	-1900	183154	-1600	0	50	0	208	209	219
1990	1	172715	56501	.9833247	73	-70	-1900	183162	-1600	0	49	0	208	209	219
1990	1	191131	56502	.9833237	75	-70	-1900	183192	-1600	0	26	0	207	209	218
1990	1	205531	56503	.9833227	73	-70	-1900	183175	-1600	0	43	0	207	207	217

4.5 Calibrated Orbital Irradiances

The orbital counts files described in Section 4.4 can be used to calculate orbital mean solar irradiances. These calculations have already been performed and are stored in 16 files called g78.data to g93.dat, where the two digits designate the year from 1978 to 1993. At this stage, an orbit was rejected if the standard deviation of either the space look or the solar look was equal to or greater than three counts. These files have 5 columns of data. They are:

1. The year of the observation.

2. The date of the observation, expressed as a day of the year and fraction of the day accurate to 5 digits beyond the decimal point. This format is chosen so that plotting of the results requires no additional computations.

3. The orbit number.

4. The unsmoothed solar irradiance in watts per square meter.

5. A Gaussian smoothed solar irradiance in watts per square meter.

A Gaussian smoothed solar irradiance is calculated in an attempt to reduce the noise level of the orbital values. Unsmoothed orbital irradiance values have considerable noise in them due to the poor resolution (0.7 W/m^2) of the A/D convertor and the limited on-Sun viewing each orbit (about 40 seconds). Much of this sampling noise can be removed by Gaussian smoothing and we feel these smoothed values can be useful in some studies. The unsmoothed values are also tabulated so that alternative smoothing procedures can be tried.

In addition to the Gaussian smoothing, we also remove an apparent shadowing effect that appears in early 1990 and grows in amplitude through 1992 (Figure 5). A step-like function appears in the data after 1990. This step-like function manifests itself as a drop of a few tenths of a watt per square meter between 1 and 6 hours UT (Figure 6). The drop is not correlated with any other measured parameter and its cause is presently unknown. Perhaps there is some shadowing effect brought about by the change in the solar-viewing geometry during the last few years of the experiment. The amplitude of the step function steadily increases from 1990 to 1993. The Gaussian program first removes this step function before the smoothing is done and uses the amplitudes for the step function listed in Table 10. A sample of original and of corrected and smoothed orbital measurements from the fall of 1992 is shown in Figure 7. The daily averages discussed in Hoyt et al. (1992) were formed from uncorrected and unsmoothed orbital measurements. However, orbits were rejected from the daily average if they were over two standard deviations from the daily mean. Taking daily averages is a form of smoothing and removes much of the digitization noise. The revised daily averages released in the spring of 1994 continued to use unsmoothed orbital values but from 1990 on excluded measurements from 1 to 6 hours UT.

The two standard deviations screen was not used in calculating the present orbital smoothed data. Thus, some noisy orbits will be accepted. One function of this screen is to reject low readings right after turn on when the sensor is not in thermal equilibrium. During the early years of the experiment, the ERB instrument was turned off at least every fourth day; thus, such orbits were fairly frequent. The user is free to revise the orbital smooth program as desired.

The following equation is used to perform the Gaussian smoothing:

$$S_{smooth} = \left[\frac{\Sigma\ S_n \exp(-(S_{n=0} - S_n)^2/\tau^2}{\Sigma\ \exp(-(S_{n=0} - S_n)^2/\tau^2)} \right] \tag{10}$$

where S is the orbital solar irradiance, tau is a time constant equal to 5 orbits, and the summation is performed from n = -25 to n = +25.

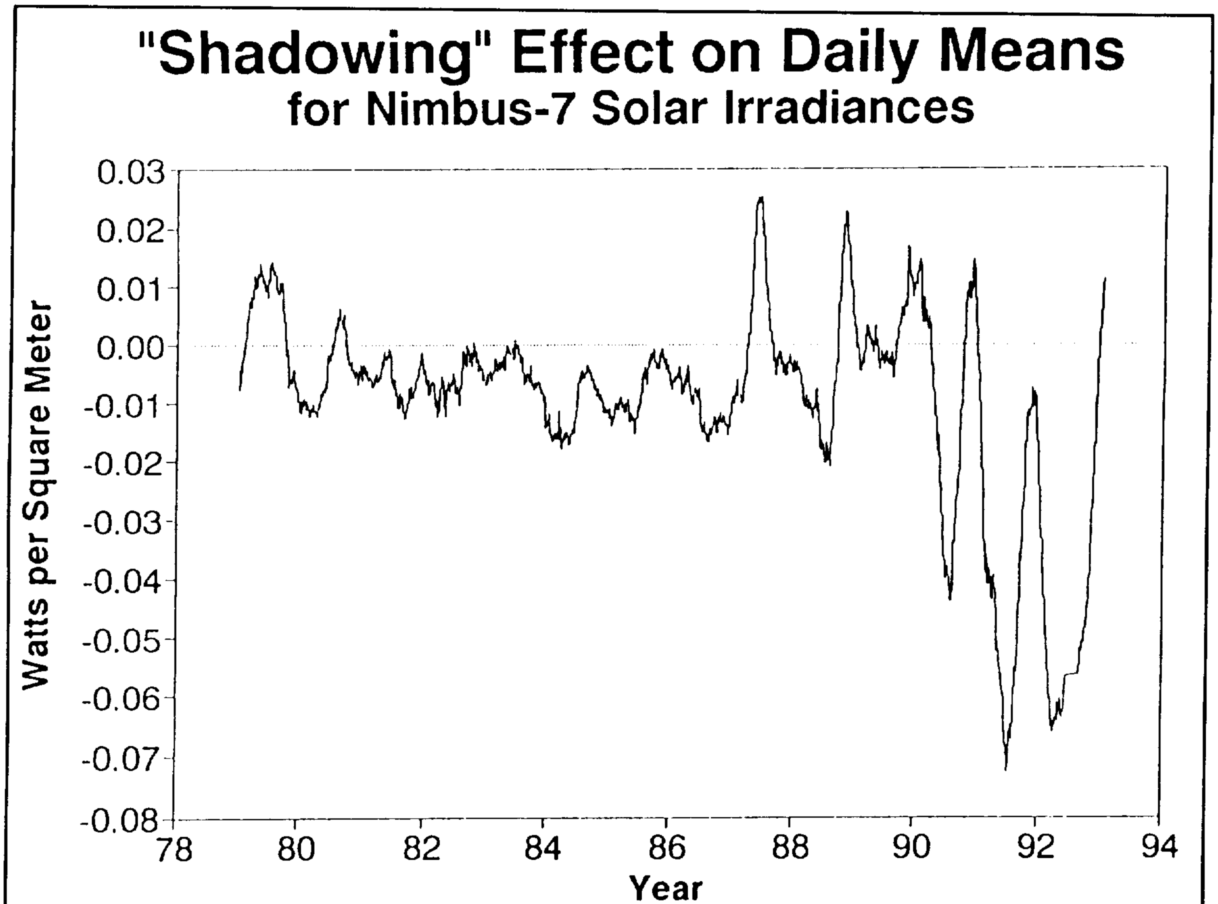

Figure 5. The onset and development of the low morning signal problem is illustrated here. The graph shows the difference (daily average minus abbreviated daily average). The abbreviated daily average is formed by omitting orbits for the period (1 to 6 hours) UT.

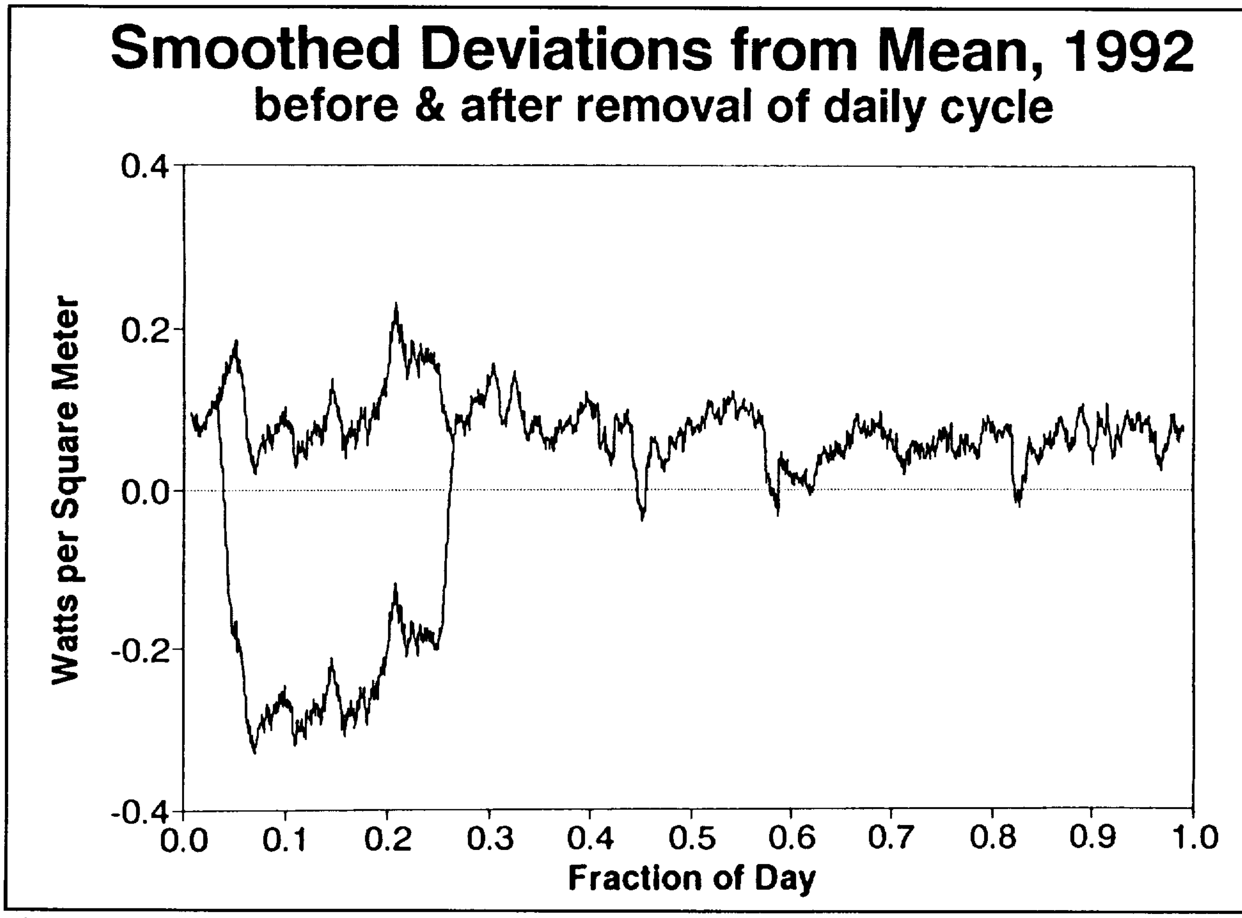

Figure 6. From 1990 onward, the mean measured signal is slightly smaller early in the observing day than it is later on. The decrease occurs from 1 to 6 hours UT or from 0.04 to 0.25 day fractions. The mean deviations from the daily mean during 1992 are shown here. Assuming that this problem is caused by some unidentified morning shadow, the measurements can be corrected as shown.

Table 10. Correction for shadowing effect between 1 and 6 hours UT.

Year	Correction (W/m^2)
<1990	0.00
1990	0.08
1991	0.25
≥1992	0.35

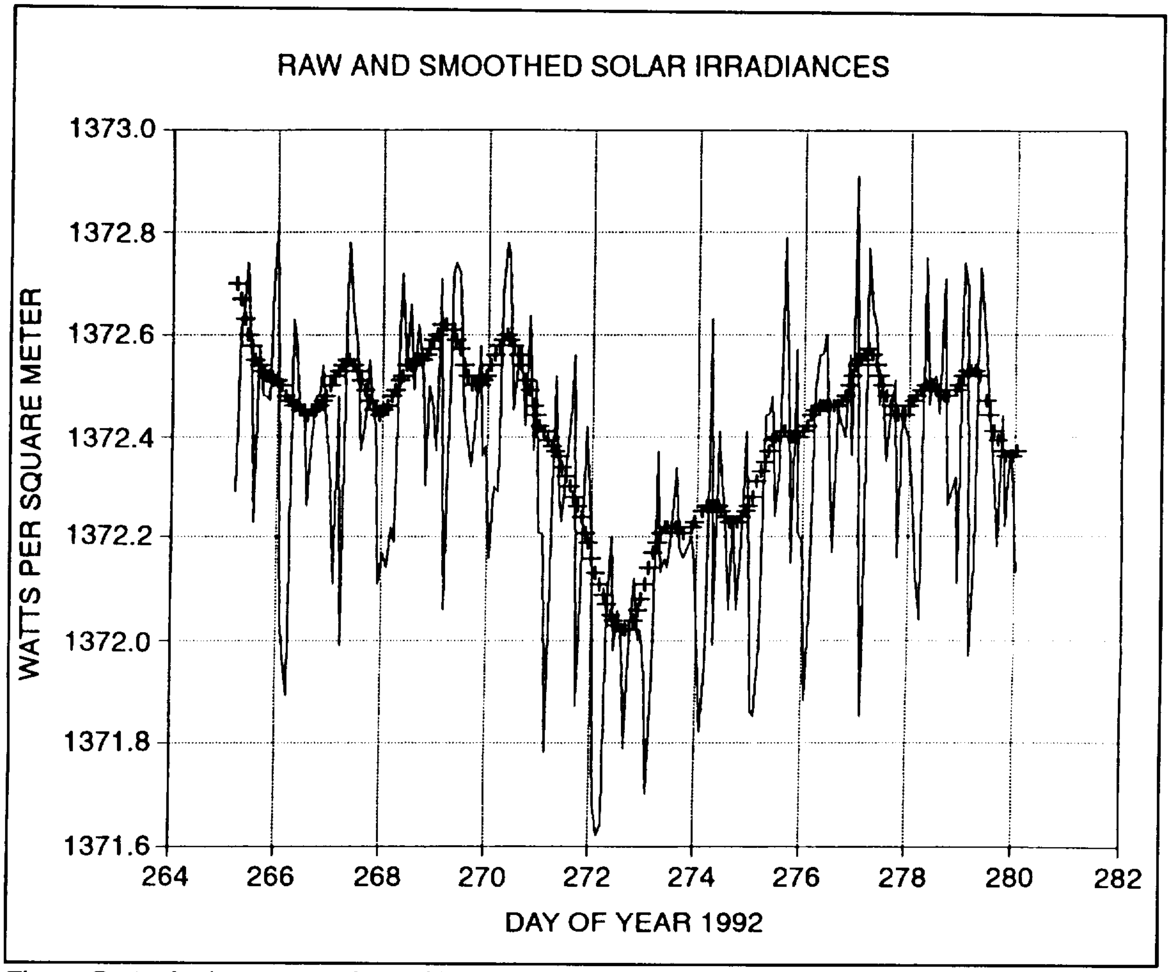

Figure 7. At the instrument, the 11-bit digitization of the measurements inserts noise at the level of ±0.35 Wm⁻² into the orbital measurements. Smoothing routines can remove most of this digitization noise. Original, corrected, and Gaussian smoothed orbital measurements are shown here for the fall of 1992 (see text).

A sample of the output files is listed in Table 11.

Table 11. Sample of the format of the orbital solar irradiance data file.

Year	Date	Orbit	S0 (W/m^2)	Smoothed S0 (W/m^2)
1990	1.07634	56492	1372.36	1372.27
1990	1.14892	56493	1372.28	1372.31
1990	1.22096	56494	1372.43	1372.36
1990	1.29355	56495	1372.14	1372.41
1990	1.36559	56496	1372.57	1372.45
1990	1.43800	56497	1372.49	1372.50
1990	1.51041	56498	1372.58	1372.55
1990	1.58263	56499	1372.55	1372.60

Table 11. Sample of the format of the orbital solar irradiance data file.				
Year	Date	Orbit	S0 (W/m^2)	Smoothed S0 (W/m^2)
1990	1.65503	56500	1372.62	1372.64
1990	1.72726	56501	1372.68	1372.69
1990	1.79966	56502	1372.81	1372.73
1990	1.87189	56503	1372.85	1372.77
1990	1.94429	56504	1372.75	1372.80

The program to perform the Gaussian smoothing and to provide the irradiance values in column five is listed below.

```
      program gauss
c
c apply Gaussian filter to orbital solar irradiances for Nimbus-7
c    using c:\counts\orbits0.dat
c also remove daily cycle in data for 1990-1993
c all ideas for program are by Douglas Hoyt, who wrote the program as well
c
      integer array1(51),tmp1(51),tmp4(51),idoy(51),tmp5(51),iyr(51)
      real*4 array2(51),rnum(51),rden(51),tmp2(51),tmp3(51)
      real*4 smooth,tau,sum1,sum2,sfrac(51)
      tau = 5.0
      icnt = 0
c orbits0.dat contains raw orbital solar irradiances
      open(5,file='c:\counts\orbits0.dat',status='old',1  form='formatted')
      open(18,file='c:\counts\g78.dat',status='new',form='formatted')
      open(19,file='c:\counts\g79.dat',status='new',form='formatted')
      open(20,file='c:\counts\g80.dat',status='new',form='formatted')
      open(21,file='c:\counts\g81.dat',status='new',form='formatted')
      open(22,file='c:\counts\g82.dat',status='new',form='formatted')
      open(23,file='c:\counts\g83.dat',status='new',form='formatted')
      open(24,file='c:\counts\g84.dat',status='new',form='formatted')
      open(25,file='c:\counts\g85.dat',status='new',form='formatted')
      open(26,file='c:\counts\g86.dat',status='new',form='formatted')
      open(27,file='c:\counts\g87.dat',status='new',form='formatted')
      open(28,file='c:\counts\g88.dat',status='new',form='formatted')
      open(29,file='c:\counts\g89.dat',status='new',form='formatted')
      open(30,file='c:\counts\g90.dat',status='new',form='formatted')
      open(31,file='c:\counts\g91.dat',status='new',form='formatted')
      do 1 i = 1, 51
      read(5,100) iyr(i),idoy(i),sfrac(i),array1(i),array2(i)
      if(i.le.15) write(18,101) iyr(i),idoy(i),sfrac(i),array1(i),
     1 array2(i),array2(i)
      if(i.le.15) write(6,101) iyr(i),idoy(i),sfrac(i),array1(i),
     1 array2(i),array2(i)
  100 format(i2,i4,f6.5,i7,f8.2)
    1 continue
  200 continue
      do 6 j = 1, 51
        tmp1(j) = array1(j)
        tmp2(j) = array2(j)
        tmp3(j) = sfrac(j)
        tmp4(j) = idoy(j)
        tmp5(j) = iyr(j)
    6 continue
c       call stddev(51,array2,ave,sig)
c       thigh = ave + 1.4*sig
c       tlow = ave - 1.4*sig
c
c remove daily cycle in 1990-1993 data
c
```

```
      do 2 j = 1, 51
       if(iyr(j).eq.90.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1    array2(j) = array2(j) + 0.08
       if(iyr(j).eq.91.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1    array2(j) = array2(j) + 0.25
       if(iyr(j).eq.92.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1    array2(j) = array2(j) + 0.35
       if(iyr(j).eq.93.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1    array2(j) = array2(j) + 0.35
    2 continue
c
        do 3 j = 1, 51
         rnum(j) = 0.0
         rden(j)= 0.0
    3   continue
        do 4 j = 1, 51
         jj = j - 26
c        if(array2(26+jj).ne.0.0) then
         rnum(j)=array2(26+jj)*exp(-((array1(26)-array1(26+jj))
     1               /tau)**2)
         rden(j)=exp(-((array1(26)-array1(26+jj))/tau)**2)
c        endif
    4   continue
        sum1 = 0.0
        sum2 = 0.0
        do 5 j = 1, 51
         sum1 = sum1 + rnum(j)
         sum2 = sum2 + rden(j)
    5   continue
       smooth = sum1/sum2
      nunit = iyr(26) - 60
      write(nunit,101) iyr(26),idoy(26),sfrac(26),tmp1(26),array2(26),
     1  smooth
      write(6,101) iyr(26),idoy(26),sfrac(26),tmp1(26),array2(26),smooth
  101 format(1x,i2,i4,f6.5,i7,2f8.2)
      do 7 j = 1, 50
       array1(j) = tmp1(j+1)
       array2(j) = tmp2(j+1)
       sfrac(j) = tmp3(j+1)
       idoy(j) = tmp4(j+1)
       iyr(j) = tmp5(j+1)
    7 continue
      read(5,100,end=9999) iyr(51),idoy(51),sfrac(51),array1(51),
     1 array2(51)
      if(iyr(51).eq.80.and.idoy(51).eq.2.and.sfrac(51).lt.0.02) then
       close(18)
       open(32,file='c:\counts\g92.dat',status='new',form='formatted')
      endif
      if(iyr(51).eq.81.and.idoy(51).eq.1.and.sfrac(51).lt.0.1) then
       close(19)
       open(33,file='c:\counts\g93.dat',status='new',form='formatted')
      endif
      if(iyr(51).eq.93.and.idoy(51).eq.348) stop
      go to 200
 9999 stop
      end
      subroutine stddev(k,s,averag,sigma)
c calculates mean and standard deviation of vector s with
c  length of k
      real*4 s(k),averag,sigma
      sum=0.0
      do 10 i=1,k
      sum=sum+s(i)
   10 continue
      averag=sum/float(k)
      sum=0.0
      do 20 i=1,k
      sum=sum+(s(i)-averag)**2
   20 continue
      if(k.eq.1) sigma=0.0
      If(k.ge.2) sigma=sqrt(sum/float(k-1))
      return
      end
```

5. PHYSICAL STRUCTURE OF THE TAPES (SST AND CST)

5.1 Tape Origins

The solar data from the Nimbus-7 ERB solar and Earth flux data tapes (SEFDT's) was extracted and compacted to form the Summary Solar Tape (SST). At the same time, the channel 10c raw counts and housekeeping data were also separately placed on the Channel 10c Solar Tape (CST). The GSFC IBM 9021 computer was used to write the compact solar data on 38,000-bpi, 3480 tape cartridges.

The ERB solar telescope had ten sensors, each of which gave one reading per second. However, the telescope could only view the sun for a few minutes out of each 104-minute orbit at satellite sunrise. On the spacecraft, the measurements were blocked into 16-second groups called major frames. Housekeeping data, consisting of time, temperatures, view angles, etc. were attached to each major frame. This general format was continued on the SEFDT and these summary tapes. All the sensor readings are recorded on the ERB Master Archive Tapes (MAT's). However, only 14.7 minutes per orbit of solar sensor readings, centered at the solar observations, were passed to the SEFDT. These consist of:

- Two major frames centered at T-13 minutes. Sensors views cold space.
- Fifty-one major frames centered at T minutes. Here T is the time at the midpoint of the solar observation.
- Two major frames centered at T+13 minutes. Sensors view cold space.

On the SEFDT there were three important types of solar data logical records. These were brought over, with no essential change, to the SST. They are:

- Type 22—Raw counts (channels 1-5)
- Type 23—Raw counts (channels 6-10)
- Type 24—Orbital summary (channels 1-10) mean counts plus irradiances

In the CST only the channel 10c raw counts and housekeeping data from the type 23 records are included since the SEFDT calibration algorithm was not accurate enough. Improved channel 10c calibration procedures are described in Hoyt et al. (1992) and Kyle et al. (1993b).

5.2 Gross Format of SST

Each Solar Summary Tape consists of a Header File and one data file for each month of data. Each data file is preceded by the NOPS Standard Header file from the SEFDT from which it was copied. Each header file consists of two blocks. The data files consist of a variable quantity of blocks. This quantity is a function of the number of data days in the month and any data gaps present.

The gross format of the Solar Summary Tape is shown below:

STD HDR	I R G	STD HDR	SEFDT #1 HDR	I R G	SEFDT #1 HDR	SEFDT #1 PHREC	I R G	SEFDT #1 PHREC	I R G	.....	SEFDT #2 HDR	I R G	SEFDT #2 HDR
File 1			File 2			File 3					File 4		

SEFDT #2 PHREC	I R G	SEFDT #2 PHREC	I R G	.....	SEFDT last HDR	I R G	SEFDT last hdr	SEFDT last PHREC	I R G	SEFDT last PHREC	I R G	.....	E O F
File 5					File N-1			File N					

Where "N" is equal to twice the number of months of data on the tape plus one.

5.3 Standard Header Record Format

All computer tapes that are generated by NOPS require some form of identification. The purpose of the NOPS Standard Header is to uniquely define the tape product and to provide version control. The format of the NOPS standard header is shown in Table 12.

Table 12. Nimbus-7 Standard Header Record Format

Character	Item	Description
1	An Asterisk	Present if TDF exists. Found to always be present. (NOTE 1)
2-23	Nimbus-7 NOPS SPEC NO T characters always present	
24-30	NOPS Specification Numbering Code	
24	T	Indicates "tape"
25	1	ERB data
26-27	34	3 = SACC, 4 = IPD (NOTE 2)
28-29	02	Tape number in sequence for subsystem
30	6	Tape Description: 6 = 6250 9-track; 7 = 3480 cartridge tape
32-38	SQ NO	Text always present
38-39	PDFC Code	AD for SEFDT; AT for Solar Data; AS for channel 10c data
40-44	NOPS Sequence Number	
40	0	Last digit of the year in which the data were acquired
41-43	123	Day of the year in which the data were acquired
44	1	Sequence number for this product: always 1 for SEFDT
45	--	A hyphen unless there is a remake of the tape. If a remake, see Record 4 of the header.
46	1	Copy Number: 1 or 2
47-52	ERB	Subsystem ID. For SEFDT, "ERB"
53-56	SACC	Subsystem ID of source facility (NOTE 2)
57-60	TO	Always "TO"
61-64	IPD	Subsystem ID of destination facility (NOTE 2)
65-70	START	Flag for Start Date

71-87	19XX ddd hhmmss	Start year, day, and time
88-91	TO	Flag for End Date
92-105	19XX ddd hhmmss	End year, day, and time
106-110	GEN	Flag for tape generation date
111-126	19XX ddd hhmmss	Start year, day, and time
127-138	SFDTMERG	Software name and version
139-144	VERH04A	Program documentation number
145-630		Comments on the data

NOTES:
(1) TDF, Trailer Documentation File. This was present on the SEFDT's, but was not copied onto the SST.
(2) The initials of old Goddard Space Flight Center computer centers.

It should be noted that the SST and CST header files do not comply exactly with the NOPS Standard Header format. The major difference lies in the Julian date present in the sequence number. Conventional NOPS header files contain the julian day of the first data day present on the tape. On the SST and CST, the sequence number contains the julian day of the first day of the final month of data present on the tape.

Here is a sample Nimbus ERB SEFDT NOPS Standard Header:

*NIMBUS-7 NOPS SPEC NO T134021 SQ NO AD83201C1 ERB SACC TO IPD START 1978 305 000000 TO 1978 334 235959 GEN 1988 258 131804 SFDTMERG VERH04A 06/22/88 VERSION 3 . 0 ALGORITHM ID: 5364CAL SET NO: 1290 SEFDTFIX 69002 SUN BLIP CLIPPING CORRECTIONS ARE APPLIED TO EARTH FLUX DATA WHEN SOLAR ZENITH ANGLE IS 99 TO 122 DEG

Here is a sample Nimbus Solar Summary Tape Label:

*NIMBUS-7 NOPS SPEC NO T132027 SQ NO AT90311C1 ERB SACC TO IPD START 1978 305 000000 TO 1979 059 235959 GEN 1992 246 155310 ESF SOLAR DATAH04A 06/22/88 VERSION 3 . 0 ALGORITHM ID: 5364CAL SET NO: 1290 SEFDTFIX 69002 SUN BLIP CLIPPING CORRECTIONS ARE APPLIED TO EARTH FLUX DATA WHEN SOLAR ZENITH ANGLE IS 99 TO 122 DEG.

Here is a sample Nimbus Channel 10c Data Tape Label:

*NIMBUS-7 NOPS SPEC NO T132027 SQ NO AS20912-2 ERB SACC TO IPD START 1978 305 000000 TO 1992 121 235959 GEN 1992 246 130443 ESF SOLAR 10C COUNTS /19/90 VERSION 3 . 0 ALGORITHM ID: 353CAL SET NO: 1290

5.4 Format of the SST Data Files

Data Format on SEFDT Tapes

Although the format of the Nimbus ERB SEFDT tapes has been adequately described in the Requirements Document[1], the following should clarify and in some cases correct this information. This information only refers to the first two files on the tape, and concentrates on Solar Data in Records with Record IDs of 22, 23, and 24.

Nimbus ERB data has a block length of 15876 characters, which encompasses 66 240-character logical records per block, followed by 36 characters used as checksums and locators for the Solar Orbital Summary records. These checksums were not used or copied.

The output solar data from record types 22, 23, and 24 were written 130 240-character records per 31200-character block. This allows more than 1 year of data to be stored on each 3480 cartridge tape. The data are stored on 14 tapes as follows:

AT93351C1 contains Solar Data for Nov. 1978 - Dec. 1979	in 30 files.
AT03361C1 contains Solar Data for Jan. - Dec. 1980	in 26 files.
AT13361B2 contains Solar Data for Jan. - Dec. 1981	in 26 files.
AT23351C2 contains Solar Data for Jan. - Dec. 1982	in 26 files.
AT33351A2 contains Solar Data for Jan. - Dec. 1983	in 26 files.
AT43361A2 contains Solar Data for Jan. - Dec. 1984	in 26 files.
AT53351A1 contains Solar Data for Jan. - Dec. 1985	in 26 files.
AT63351A1 contains Solar Data for Jan. - Dec. 1986	in 26 files.
AT73331-2 contains Solar Data for Jan. - Dec. 1987	in 26 files.
AT83342-2 contains Solar Data for Jan. - Dec. 1988	in 26 files.
AT93342-2 contains Solar Data for Jan. - Dec. 1989	in 26 files.
AT03352-2 contains Solar Data for Jan. - Dec. 1990	in 26 files.
AT13332-2 contains Solar Data for Jan. - Dec. 1991	in 26 files.
AT30032-2 contains Solar Data for Jan. 1992 - Jan. 1993	in 28 files.

Of the five types of Nimbus ERB SEFDT logical records, data from Types 22, 23, and 24 were copied to Solar Data tapes with minor changes in format, as shown in Tables 13 and 14.. The 10c counts and related data from the type 23 solar records were copied to the Solar 10c-count tape files in a special format shown in Table 15.

[1]Nimbus-7 NOPS Requirements Document #NG-15, ERB SEFDT Tape Specification No. T134021, Version I, April 1985.

Table 13. Format of the Solar Summary Tapes (SST) Data Files
(The format of the first 40 characters of each logical record is identical for all types of solar data records.)

Characters	Format	Variable Description	
1-4	Octal	Physical Record No., Spares, File Cont, Record ID and Logical Record No. in a format not easily usable on IBM equipment	
5-6	I*2	Physical Record No. within the file	
7-8	I*2	SEFDT Record Type 22: Channels 1-5 solar data 23: Channels 6-10 solar data 24: Solar Summary data	
9-10	I*2	Logical Record No. within the Physical Record, 1-66. Meaningless in output data	
11-12	I*2	Algorithm ID. Not used by us	
13-14	I*2	Calibration Set no. in input data, obliterated by I*4 Orbit Number in output data	
15-16	I*2	Orbit Number on input tapes	
13-16	I*4	Orbit number on output tapes	
17-18	I*2	Year, last 2 digits	
19-20	I*2	Day of year	
21-22	I*2	GMT hours/minutes: hours * 100 + minutes	
23-24	I*2	GMT seconds	
25-26	I*2	Solar azimuth * 10	
27-28	I*2	Solar elevation * 10	
29-30	I*2	Solar right ascension * 100	
31-32	I*2	Solar declination * 100	
33-34	I*2	Instrument status word	
35-36	I*2	Gamma angle (recalculate this; see Sections 2.3 and 4.2.2)	
37-40	I*4	Sun-Earth distance in A.U. * 100,000. An approximate value	
The format of the data groups for Types 22 and 23 solar data records:			
41-60	10I*2	Thermopile Base Temperatures in centigrade for channels 1 through 10, * 10	
61-220	10(16I *2)	16 digital counts for each of 5 channels, depending on type	
		Type 22 Channel	Type 23 Channel
61-92	16I*2	1	6
93-126	16I*2	2	7
127-156	16I*2	3	8
157-188	16I*2	4	9
189-220	16I*2	5	10
221-220	16I*2	Miscellaneous Solar Assembly Temperatures	
221-222	I*2	Channel 1S Module Temperature	
223-224	I*2	Channel 2S Module Temperature	
225-226	I*2	Channel 3S Module Temperature	
227-228	I*2	Channel 6S Module Temperature	

Table 13. Format of the Solar Summary Tapes (SST) Data Files (The format of the first 40 characters of each logical record is identical for all types of solar data records.)		
Characters	Format	Variable Description
229-230	I*2	Channel 9S Module Temperature
231-232	I*2	Channel 10S Module Temperature
233-234	I*2	Solar Channel Assembly, Top
235-236	I*2	Solar Channel Assembly, Bottom
237-238	I*2	Solar Assembly Drive Motor Temperature

Table 14. Format of the Solar Orbital Summary Records (The format of the data groups for Type 24 Solar Data Records)		
Characters	Format	Variable Description
41-60	10I*2	Thermopile Base Temperatures in centigrade for channels 1 through 10, * 10
61-120	10(3I*2)	Mean Counts for each channel, formatted as shown, and not as shown in the Requirements Document
61-80	10I*2	To - 13 minutes for channels 1-10
81-100	10I*2	To for channels 1-10
101-120	10I*2	To + 13 minutes for channels 1-10
121-140	10I*2	Net Solar Irradiance in W/m^2 for channels, scaled as shown
121-122	I*2	Channel 1 * 10
123-124	I*2	Channel 2 * 10
125-126	I*2	Channel 3 * 10
127-128	I*2	Channel 4 * 10
129-130	I*2	Channel 5 * 10
131-132	I*2	Channel 6 * 100
133-134	I*2	Channel 7 * 100
135-136	I*2	Channel 8 * 100
137-138	I*2	Channel 9 * 100
139-140	I*2	Channel 10 * 10
141-142	I*2	GMT HHMM of southern terminator crossing
143-144	I*2	GMT Seconds of southern terminator crossing

5.5 Gross Format of CST

There are two channel 10c Summary Tapes. The first contains data for the period November, 1978 through December 1990. The second tape contains data from January, 1991 through January, 1993. Each tape consists of a header file and one data file for each month of data present. The header file consists of two blocks. The data files contain a variable quantity of blocks.

The gross format of the Channel 10c Summary Tape is shown below:

STD HDR	I R G	STD HDR	SEFDT #1 PHREC	I R G	SEFDT #1 PHREC	I R G	.....	SEFDT #2 PHREC	I R G	SEFDT #2 PHREC	I R G	.....
File 1			File 2					File 3				

SEFDT LAST PHREC	I R G	SEFDT LAST PHREC	I R G	.....	E O F
File N					

Where "N" is equal to the number of months of data on the tape plus one.

5.6 Format of the CST Data Files

A total of 475 68-character Channel 10c data records were written per 32,300-character block. This allows 12 years of the 10c data to be written on a single 3480 cartridge tape. A filled data gap exists for March 1988. A special Nimbus header record appears in files 1 and 148 of tape 1 and file 1 of tape 2. The other files correspond to the following dates:

Tape 1. AS03352-2	
November and December 1978	Files 2 and 3
January through December 1979	Files 4 - 15
January through December 1980	Files 16 - 27
January through December 1981	Files 28 - 39
January through December 1982	Files 40 - 51
January through December 1983	Files 52 - 63
January through December 1984	Files 64 - 75
January through December 1985	Files 76 - 87
January through December 1986	Files 88 - 99
January through December 1987	Files 100 - 111
January through December 1988	Files 112 - 123
January through December 1989	Files 124 - 135
January through December 1990	Files 136 - 147
Tape 2. AS30032-2	
January through December 1991	Files 2 - 13
January through December 1992	Files 14 - 25
January 1993	File 26

Table 15. Format of the Solar 10c Count Tapes Data Files		
Characters	Format	Variable Description
1-4	I*4	The Orbit No., read and written A4
5-8	I*4	A filler value of 9999, representing the Sun-Earth distance
The next 60 spaces contain an array of 30 I*2 items that are read and written A2		
9-10	I*2	SA(1) = Physical Record No.
11-12	I*2	SA(2) = Record Type: Always 23
13-14	I*2	SA(3) = Year
15-16	I*2	SA(4) = Day of Year
17-18	I*2	SA(5) = HHMM of Day
19-20	I*2	SA(6) = Second of HHMM of day
21-22	I*2	SA(7) = Solar Azimuth * 10
23-24	I*2	SA(8) = Solar Elevation * 10
25-26	I*2	SA(9) = Solar Right Ascension * 100
27-28	I*2	SA(10) = Solar Declination * 100
29-30	I*2	SA(11) = Instrument Status Word
31-32	I*2	SA(12) = Gamma Angle (recalculate; see Sections 2.3 and 4.2.2)
33-34	I*2	SA(13) = 10c Thermistor Base Temp * 10
35-36	I*2	SA(14) = Channel 10c Module Temp * 10
37-68	16I*2	SA(15) = (30): Chan. 10c bit samples T = To - (To + 15)

5.7 Program to Read the Solar Summary Tape (SST)

A program to read the logical data records 22 and 23 from the SST is given below. It is written in Fortran and was run on an IBM 9021 computer to produce the sample output given in Table 16 for January 1, 1984.

```
***********************************************************************
***             PROGRAM TO READ SOLAR SUMMARY TAPES (SST)           ***
***                                                                 ***
***  THIS PROGRAM READS AN SST TAPE. IT CAN BE MODIFIED AS SHOWN    ***
***  FOR ANY OF THE  14  SST TAPES. IT CAN BE MODIFIED AS SHOWN     ***
***  TO ANY OR ALL SOLAR PARAMETERS FROM THESE TAPES.               ***
***                                                                 ***
***  THE VARIABLE IREC CONTAINS THE NUMBER OF BLOCKS PER FILE ON    ***
***  THE SST TAPE. THESE CAN BE OBTAINED BY RUNNING A TAPESCAN      ***
***  OF THE SUBJECT SST.                                            ***
***                                                                 ***
***  THE VARIABLES SOL AND SOL4 CONTAIN THE OUTPUT SOLAR PARA-      ***
***  METERS. THE ORDER OF THESE VARIABLES CAN BE OBTAINED FROM      ***
***  THE USER'S GUIDE. THE MAJOR ONES ARE SUMMARIZED BELOW.         ***
***                                                                 ***
***  RECORD ID        SOL(4)
***  ORBIT NUMBER     SOL(8)
***  YEAR             SOL(9)
***  JULIAN DAY       SOL(10)
***  GMT HOURS/MIN.  SOL(11)
***  SECONDS          SOL(12)
***  SOLAR AZIMUTH    SOL(13)
***  SOLAR ELEVATION SOL(14)
```

```
***   SOLAR RA         SOL(15)
***   SOLAR DECLIN.  SOL(16)
***   GAMMA ANGLE      SOL(18)
***   EARTH/SUN DIST. SOL(19)
***
***   FOR DATA RECORDS 22
***
***    CHANNEL 1-5 DIGITAL COUNTS      SOL(31) THROUGH SOL(110)
***
***
***   FOR DATA RECORDS 23
***
***    CHANNEL 6-10 DIGITAL COUNTS      SOL(31) THROUGH SOL(110)
***
**********************************************************************
       CHARACTER*1 LOGREC(240,130)
       INTEGER*2 SOL(120,130)
       INTEGER*4 SOL4(60,130)
       INTEGER M(10,2), SOLI4
       CHARACTER*1 HEADER(630)
       INTEGER IREC(12)/366,331,366,355,366,355,367,367,
     *                  355,355,355,357/
       EQUIVALENCE (SOL,LOGREC), (SOL4,LOGREC)
*************************
***** MOUNT SST TAPE
*************************
       CALL POSN(1,10,1)
*************************
***** READ AND WRITE SST TAPE HEADERS
*************************
       CALL FREAD(HEADER,10,N,*98,*99)
       WRITE(6,1001) HEADER
1001   FORMAT(80A1)
       CALL FREAD(HEADER,10,N,*98,*99)
       WRITE(6,1001) HEADER
       ITEST=1
*************************
***** LOOP OVER 12 MONTHS OF DATA
*************************
       DO 999 IMON=1,1
          IFILE=IMON*2
*************************
***** POSITION TO FILE FOR DESIRED MONTH
*************************
          CALL POSN(1,10,IFILE)
*************************
***** READ SEFDT HEADERS FOR DESIRED MONTH
*************************
          CALL FREAD(HEADER,10,N,*98,*99)
          WRITE(6,1001) HEADER
          CALL FREAD(HEADER,10,N,*98,*99)
          WRITE(6,1001) HEADER
          JFILE=IFILE+1
*************************
***** POSITION FOR DATA FOR DESIRED MONTH
*************************
          CALL POSN(1,10,JFILE)
*************************
***** LOOP OVER THE NUMBER OF RECORDS FOR THIS MONTH
*************************
          DO 10 I=1,IREC(IMON)
1003      FORMAT(/I6/)
          CALL FREAD(LOGREC,10,N,*98,*99)
1005      FORMAT('BYTES READ=',I10)
*************************
***** LOOP OVER THE 130 RECORDS PER BLOCK
*************************
          DO 20 K=1,130
            IF(SOL(10,K).GT.2) GO TO 999
             IF(K.EQ.1) WRITE(6,1006)
             IF(K.EQ.47) WRITE(6,1006)
             IF(K.EQ.95) WRITE(6,1006)
1006         FORMAT('1',' YR  DAY  HMN   SEC REC   SOLAZ  SOLELV  GAM',
```

```
     *              '    ORB     CH1/6    CH2/7    CH3/8    CH4/9   CH5/10')
****************************
***** ADD 65536 FOR ORBITS AFTER APRIL 20, 1985
****************************
           IORB=SOL(8,K)
           IF((SOL(9,K).GE.85).AND.(SOL(10,K).GT.110))
     *        IORB=IORB+65536
****************************
***** PRINT OUT SELECTED PARAMETERS
****************************
           WRITE(6,1002) SOL(9,K),SOL(10,K),SOL(11,K),SOL(12,K),
     *       SOL(4,K),SOL(13,K),SOL(14,K),SOL(18,K),IORB,
     *       SOL(31,K),SOL(47,K),SOL(63,K),SOL(79,K),SOL(95,K)
1002       FORMAT(1X,I4,I5,I5,I6,I4,2I8,I5,6I8)
20    CONTINUE
 10   CONTINUE
999   CONTINUE
      GO TO 998
 98   CONTINUE
 99   WRITE(6,1004)
1004  FORMAT('READ ERROR')
998   CONTINUE
      STOP
      END
```

The column headings in Table 16 refer to items in the SST format Table 13. They are as follows:

Column	Heading	Description
1	Year	Last two digits
2	Day	Day of year
3	HMN	Hours and minutes written together; the first line is for 1 hour and 37 minutes
4	Sec	seconds
5	Rec	Logical record number, either 22 or 23
6	Solaz	Solar azimuth angle in (degrees x 10); the no data fill value is -9999
7	Solelv	Solar elevation angle (degrees x 10)
8	Gam	Gamma angle in integer degrees; this is the telescope pointing angle (see Sections 2.3 and 4.2.2)
9	Orb	Orbit number since launch
10	Ch1/6	The first integer counts signal (measurement) in the record for channel 1 (if record 22) or channel 6 (if record 23); there are 16 measurements for each of channels 1-5 in record 22 and for channels 6-10 in record 23; only the first are written here
11-14	Ch2/7, Ch3/8, Ch4/9, Ch5/10	As above but for the indicated channels

Table 16. Sample Output From SST Tape													
Year	Day	HMN	Sec	Rec	Solaz	Solelv	Gam	Orb	Ch1/6	Ch2/7	Ch3/8	Ch4/9	Ch5/10
1984	1	137	0	22	-9999	-9999	0	26189	-3	-1	-16	-1	-3
1984	1	137	0	23	-9999	-9999	0	26189	-11	-22	-38	-43	-19
1984	1	137	16	22	-9999	-9999	0	26189	-3	-1	-16	-1	-3
1984	1	137	16	23	-9999	-9999	0	26189	-10	-21	-38	-42	-19
1984	1	143	40	22	2	224	0	26189	-3	11	-13	12	11
1984	1	143	40	23	2	224	0	26189	14	-2	-16	-9	-17
1984	1	143	56	22	2	214	0	26189	-3	12	-13	16	17
1984	1	143	56	23	2	214	0	26189	18	4	-13	-4	-18
1984	1	144	12	22	2	205	0	26189	-3	13	-13	21	22
1984	1	144	12	23	2	205	0	26189	27	11	-6	12	-17
1984	1	144	28	22	2	196	0	26189	-3	15	-12	25	28
1984	1	144	28	23	2	196	0	26189	34	17	-2	28	-18
1984	1	144	44	22	2	188	0	26189	-3	15	-11	30	34
1984	1	144	44	23	2	188	0	26189	40	23	3	43	-17
1984	1	145	0	22	2	179	0	26189	-3	16	-11	36	40
1984	1	145	0	23	2	179	0	26189	48	29	8	58	-17
1984	1	145	16	22	2	170	0	26189	-3	18	-7	43	48
1984	1	145	16	23	2	170	0	26189	57	37	13	72	-17
1984	1	145	32	22	2	161	0	26189	-3	20	-4	52	57
1984	1	145	32	23	2	161	0	26189	65	44	17	84	-17
1984	1	145	48	22	2	152	0	26189	-3	23	-1	61	66
1984	1	145	48	23	2	152	0	26189	73	51	21	93	-17
1984	1	146	4	22	2	143	0	26189	-3	26	2	70	76
1984	1	146	4	23	2	143	0	26189	79	57	25	106	-16
1984	1	146	20	22	2	134	0	26189	-3	28	3	95	100
1984	1	146	20	23	2	134	0	26189	128	95	39	219	-16
1984	1	146	36	22	2	124	0	26189	-3	60	7	255	258
1984	1	146	36	23	2	124	0	26189	281	217	121	395	-15
1984	1	146	52	22	2	115	0	26189	-3	210	135	444	441
1984	1	146	52	23	2	115	0	26189	442	351	220	584	-14
1984	1	147	8	22	2	106	0	26189	-3	376	324	636	629
1984	1	147	8	23	2	106	0	26189	602	490	326	775	50
1984	1	147	24	22	2	97	0	26189	-3	547	522	821	820
1984	1	147	24	23	2	97	0	26189	767	633	434	972	251

1984	1	147	40	22	2	87	0	26189	-3	723	726	997	1009
1984	1	147	40	23	2	87	0	26189	932	777	543	1170	509
1984	1	147	56	22	2	78	0	26189	-3	899	930	1163	1187
1984	1	147	56	23	2	78	0	26189	1093	916	651	1368	796
1984	1	148	12	22	2	69	0	26189	-3	1069	1129	1321	1353
1984	1	148	12	23	2	69	0	26189	1247	1049	753	1559	1096
1984	1	148	28	22	2	60	0	26189	-3	1233	1326	1471	1507
1984	1	148	28	23	2	60	0	26189	1393	1175	850	1743	1396
1984	1	148	44	22	2	51	0	26189	-3	1384	1521	1614	1655
1984	1	148	44	23	2	51	0	26189	1520	1289	941	1916	1667
1984	1	149	0	22	2	41	0	26189	-3	1494	1677	1645	1714
1984	1	149	0	23	2	41	0	26189	1525	1301	966	2025	1823

5.8 Program to Read the Channel 10c Summary Tape (CST)

The program is written in Fortran and run on an IBM 9021 computer to produce the sample output given in Table 17. This program was designed as a quality control, review program. The Sun is viewed once each 104-minute orbit. The solar observations are grouped into 55 major frame records each containing 16 1-second measurements. For each recorded orbital viewing, the program picks out the maximum reading (MAXCNT) and also gives, for all of the present major frames, the sum of the counts (totcount) and the average count (AVGCNT). The first nine columns in Table 17 refer to quantities described in the CST format, Table 15. The last two columns give statistics. A monthly summary is given in Table 18. Table 18 should be self explanatory.

```
C  READ10C PROGRAM BY D. LOVE, S.M.A.R.T. INC AT GSFC          9/17/92
C
C  This program reads the 10c data for a month,
C  and takes orbital maxima and averages.
C  Monthly averages are saved on diskfile SMDLL.MONTHLY.TENCDATA.
C
C  Data is stored in the 10-c files in the following format:
C
C  The ORBIT NO. is stored in the first 4 spaces, read/written A4.
C  A filler value of 9999 is stored in the second 4 spaces, written A4.
C  The next 60 spaces contain 30 I*2 variables read/written A2:
C
C  SA(1) = Physical Record No.     SA(9)  = Solar Right Ascension *100
C  SA(2) = Record Type: always 23. SA(10) = Solar Declination     *100
C  SA(3) = Year                    SA(11) = Instrument Status Word
C  SA(4) = Day of year             SA(12) = Gamma Angle
C  SA(5) = HHMM of Day             SA(13) = 10c Thermistor Base Temp*10
C  SA(6) = Second of HHMM of day   SA(14) = Chan. 10C Module Temp. * 10
C  SA(7) = Solar Azimuth   * 10    SA(15) - (30): Chan. 10c bit samples
C  SA(8) = Solar Elevation * 10             T = To - (To + 15)
C
C  VARIABLES:
C
C     INTEGER*2 SA(30)             The Array of Channel 10 bit samples
C     INTEGER*2 MAX2               Max. count value found in each orbit
C     INTEGER*2 MAX                Maximum count value found in month
C     INTEGER*2 IYR                Year (last 2 digits)
C     INTEGER*2 DAY1               First Day Of Year found
```

```
C     INTEGER*2 DAY                  Day Of Year of Maximum Count
C     INTEGER*2 HH                   The hour of the day at Maximum Count
C     INTEGER*2 MM                   The minute of the hour at Max. Count
C     INTEGER*2 SEC                  The second at Max. Count
C     INTEGER*4 ITOT                 Total of counts in each orbit
C     INTEGER*4 ICNT                 Records read per month count
C     INTEGER*4 NORB                 Orbit found in record
C     INTEGER*4 NORPRE               Previous orbit found
C     INTEGER*4 IORB1                First orbit found
C     INTEGER*4 NORBS                No. of orbits found
C     INTEGER*4 CPORB                Counts per orbit
C     INTEGER*4 L                    Line on page
C     INTEGER*4 P                    Page no.
C     REAL*4    AVG                  Average of counts in each orbit
C     REAL*4    AVGA                 Average of maximum counts/orbit
C     REAL*4    AVGC                 Average of 10C base temp.
C     REAL*4    AVGS                 Average of 10C Module temp.
C     REAL*4    AVGM                 Average of maximum counts
C     REAL*4    M10C                 Maximum Channel 10C base temp.
C     REAL*4    M10S                 Maximum Channel 10C Module temp.
C     REAL*4    TENC                 Channel 10C base temperature
C     REAL*4    TENS                 Channel 10C Module temperature
C     REAL*4    MAXC                 maximum 10c base temperature found
C     REAL*4    MAXS                 maximum 10C module temperature found
C     REAL*4    TENCM                10C base temp. at maximum count
C     REAL*4    TENSM                10C module temp. at maximum count
C     REAL*4    TOTA                 Total of counts for all orbits
C     REAL*4    TOTC                 Total of channel 10c base temperatures
C     REAL*4    TOTS                 Total of channel 10c module temperatures
C     REAL*4    TOTM                 Total of maximum counts
C
      INTEGER*2 SA(30), MAX2, MAX, HH, MM, SEC, DAY1, IYR, DAY
      INTEGER*4 ITOT, ICNT, NORB, NORPRE, IORB1, NORBS, L, P, CPORB
      REAL*4    TOTA, TOTC, TOTS, TOTM, AVG, AVGA, AVGC, AVGS, AVGM
      REAL*4    AZ, EL, RA, DE, TENC, TENS, M10C, M10S, MAXC, MAXS
C
      DATA      MAX, MAX2, DAY1 / 2*-32000, 0 /
      DATA      MAXC, MAXS / 2*-32000. /
      DATA      ITOT, ICNT, L, P, NORBS, NORPRE, CPORB / 7*0 /
      DATA      TOTA, TOTC, TOTS, TOTM, M10C, M10S / 6*0.0 /
C
 10   WRITE (6,60)
 60   FORMAT ('1', 22X, 'Display of 10-C data for one month for each',
     2        ' orbit:', //,
     3        ' ORBIT YRDAY HH MM SS  AZH: ELEV:   GAMMA: ',
     4        ' TB10C: TM10C: MAXCNT: TOTCOUNT: AVGCNT:', /)
C
 1    READ (8,8,END=9,ERR=1) NORB, SA
 8    FORMAT (A4, 4X, 30A2)
      ICNT = ICNT + 1
      CPORB = CPORB + 16
      IF (DAY1 .EQ. 0) DAY1 = SA(4)
      IF (IORB1 .EQ. 0) IORB1 = NORB
      IF (NORPRE .EQ. 0) NORPRE = NORB
      TENC = SA(13) / 10.
      TENS = SA(14) / 10.
C
C     Look at each count value
C
      DO 16 I = 15, 30
C
C     SAVE VALUES FOR MAXIMUM COUNT
C
         IF (MAX2 .LT. SA(I)) THEN
            MAX2 = SA(I)
            IYR  = SA(3)
            DAY  = SA(4)
            HH   = SA(5) / 100
            MM   = SA(5) - HH*100
            SEC  = SA(6)
            AZ   = SA(7) / 10.
            EL   = SA(8) / 10.
            RA   = SA(9) / 100.
```

```
             DE   = SA(10)/ 100.
             GAM  = SA(12)/1.
             M10C = TENC
             M10S = TENS
          END IF
C
C     Eliminate bad counts (< -99)
C
          IF (SA(I) .LT. -99) THEN
             CPORB = CPORB - 1
          ELSE
             ITOT = ITOT + SA(I)
          END IF
  16      CONTINUE
C
C     SAVE TOTALS FOR FINAL AVERAGING
C
      TOTC = TOTC + TENC
      TOTS = TOTS + TENS
      IF (MAXC .LT. TENC) MAXC = TENC
      IF (MAXS .LT. TENS) MAXS = TENS
C
      IF (NORPRE .NE. NORB) THEN
C
C     WRITE VALUES FOR MAXIMUM COUNT
C
         AVG = ITOT / CPORB
         TOTA   = TOTA + ITOT
         TOTM   = TOTM + MAX2
         IF (MAX2 .GT. MAX) MAX = MAX2
         CPORB  = 0
         NORPRE = NORB
         NORBS  = NORBS + 1
C
         WRITE (6,6) NORPRE, IYR, DAY, HH, MM, SEC, AZ, EL, GAM,
     2               M10C, M10S, MAX2, ITOT, AVG
   6     FORMAT (I6, I3, I3.3, I3, 2(':', I2.2), 2F6.1, F8.2,
     2           2F7.1, I8, I10, F8.2)
         ITOT = 0
         MAX2 = -32000
C
         L = L + 1
         IF (L .GE. 50) THEN
            P = P + 1
            L = 0
            WRITE (6,69) P
  69        FORMAT (//, 40X, ' -', I3, ' -')
            GO TO 10
         END IF
      END IF
C
      GO TO 1
C
   9  DO 91 I = L, 50
         WRITE (6,61)
  61     FORMAT (1X)
  91  CONTINUE
C
      P = P + 1
      WRITE (6,69) P
C
      AVGA = TOTA / NORBS
      AVGM = TOTM / NORBS
      AVGC = TOTC / ICNT
      AVGS = TOTS / ICNT
C
      WRITE (6,66) ICNT, SA(3), DAY1, SA(3), SA(4), IORB1, NORB, NORBS,
     2             MAX, AVGM, AVGA, MAXC, AVGC, MAXS, AVGS
  66  FORMAT ('1', 30X, 'SUMMARY OF RESULTS FOR MONTH:', //,
     2        ' A total of', I6, ' records for ', I3, I3.3, ' - ',
     3         I3, I3.3, /, ' covering orbits ', I6, ' -', I6, ' = ',
     4         I6, ' orbits. ', //, 10X,
     5        ' Maximum value count in month:  ', I7,    /, 10X,
```

```
     6        ' Average of maximum counts:     ', F10.2, /, 10X,
     7        ' Average of all good counts:    ', F10.2, /, 10X,
     8        ' Maximum 10c base temperature in month:    ', F10.2  /, 10X,
     9        ' Average 10c base temperature:  ', F10.2, /, 10X,
     *        ' Maximum 10c module temperature in month:    ', F10.2  /, 10X,
     1        ' Average 10c module temperature:', F10.2)
C
C
      STOP
      END
END OF DATA
```

Column Headings for Table 17

Column	Heading	Description
1	Orbit	Orbit since launch
2	YRDAY	87305 reads 1987, day 305
3	HH:MM:SS	Hours, minutes, and seconds
4	AZH	Solar azimuth angle from orbit plane in degrees
5	Elev	Solar elevation from satellite velocity vector in degrees
6	Gamma	Telescope pointing angle from the orbit plane in degrees (see Sections 2.3 and 4.2.2)
7	TB10C	The thermistor base temperature for channel 10c (°C)
8	TM10C	The module temperature for channel 10c (°C)
9	MAXCNT	The maximum channel 10c count in this orbit
10	TOTCOUNT	The sum of the channel 10c counts for this solar observation
11	AVGCNT	The average channel 10c reading during this observation

Table 17. Sample CST Summary for a Few Orbits

Orbit	YRDAY	HH:MM:SS	AZH	ELEV	GAMMA	TB10C	TM10C	MAXCNT	TOTCOUNT	AVGCNT
45543	87305	0:50:54	0.0	1.8	0.00	20.7	20.7	1796	511725	571.00
45544	87305	2:35:10	0.0	1.5	0.00	20.7	20.7	1796	510096	579.00
45545	87305	4:19:26	0.0	1.0	0.00	20.8	20.8	1796	510130	579.00
45546	87305	6:03:58	0.0	-0.1	0.00	20.9	20.9	1797	513664	583.00
45547	87305	7:47:42	0.0	1.2	0.00	20.9	20.9	1796	516002	586.00
45548	87305	9:32:14	0.0	0.0	0.00	20.9	20.9	1797	514695	584.00
45549	87305	11:16:14	0.0	0.6	0.00	21.0	20.9	1797	511963	581.00
45550	87305	13:00:14	0.0	1.0	0.00	21.1	21.0	1797	512149	581.00
45551	87305	14:44:14	0.0	1.5	0.00	21.1	21.1	1797	512571	582.00
45552	87305	16:28:14	0.0	2.0	0.00	21.1	21.0	1797	511403	581.00
45553	87305	18:12:46	0.0	0.8	0.00	21.0	21.0	1797	484727	550.00
45554	87305	19:56:46	0.0	1.4	0.00	20.9	20.9	1797	514087	584.00
45555	87305	21:41:18	0.0	0.0	0.00	20.8	20.8	1797	362233	411.00
45556	87305	23:25:02	0.0	1.5	0.00	20.7	20.7	1797	512902	582.00

45557	87306	1:09:18	0.0	1.2	0.00	20.7	20.7	1797	511554	581.00
45558	87306	2:53:18	0.0	1.7	0.00	20.7	20.7	1797	510486	580.00
45559	87306	4:37:34	0.0	1.3	0.00	20.8	20.8	1797	512487	582.00
45560	87306	6:21:34	-0.1	1.9	0.00	20.9	20.8	1797	516189	586.00
45561	87306	8:06:22	0.0	-0.2	0.00	20.9	20.9	1798	515966	586.00
45562	87306	9:50:22	0.0	0.3	0.00	20.9	20.9	1798	516490	586.00
45563	87306	11:34:06	-0.3	1.7	0.00	21.0	20.9	1797	514603	584.00
45564	87306	13:18:38	0.0	0.4	0.00	21.2	21.1	1798	514831	585.00
45565	87306	15:02:38	0.0	0.9	0.00	21.2	21.2	1798	510912	580.00
45566	87306	16:46:54	0.0	0.5	0.00	21.2	21.2	1798	512543	582.00
45567	87306	18:30:54	-0.1	1.0	0.00	21.1	21.1	1798	515308	585.00

Table 18. CST Review (summary of results for month)	
A total of 22825 records for 87305-87334 covering orbits 45542-45956 = 414 orbits	
Maximum value count in month	1821
Average of maximum counts	1809.58
Average of all good counts	506852.94
Maximum 10c base temperature in month	29.00
Average 10c base temperature	21.14
Maximum 10c module temperature in month	22.60
Average 10c module temperature	21.09

Data Problems or Errors

The processing program originally detected many nonsequential dates in the data for Type 24 records. When it was realized that the data were stored by Record Type, then by date, the program was modified and no further warning messages occurred, except for one record on tape FIX905. This tape contains one record that is 15877 bytes long, which cannot be read. The 66 logical records in this tape record were to have been left out of the data, but the output record count indicates that some of them have been included.

The data gap for March 1988 is filled with 2-record files of the following type:

- Missing Header records are represented by the character string:
  This file is saved for the Nimbus Label for missing tape FIXD04.

- Missing data records are represented by the character string:
  This file is saved for the Nimbus Data from missing tape FIXD04.

- 10c count missing records are presented by the character string:
  This file is saved for the Nimbus 10c counts from missing tape FIXD04.

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13. ABSTRACT *(Maximum 200 words)*

Nimbus-7 Earth Radiation Budget (ERB) solar measurements extend from November 16, 1978, to December 13, 1993, but with data gaps in 1992 and 1993. The measurements include the total solar irradiance plus six broadband spectral components. The Channel 10c total irradiance data appears very stable, and the calibration, well done. A number of characterization problems remain in the spectral measurements. In the original program, the solar and Earth flux measurements were intermixed and spread over about 170 computer tapes. For easier access, the solar data have been collected into two compact data sets. All of the data are collected into 14 Summary Solar Tapes (SSTs). In addition, two Channel 10c Solar Tapes (CSTs) give a separate listing of the stable total solar irradiance measurements. Channel 10c calibration and orbital irradiance values are given on separate PC disks. This document gives data descriptions and formats, together with quality control and calibration procedures.

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