NOAA Technical Memorandum ERL SEL-56

SMS-GOES SOLAR SOFT X-RAY MEASUREMENTS
PART I. SMS-1, SMS-2, AND GOES-1 MEASUREMENTS FROM JULY 1, 1974, THROUGH DECEMBER 31, 1976

R. F. Donnelly

Space Environment Laboratory
Boulder, Colorado
May 1981

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / Environmental Research Laboratories

NOAA Technical Memorandum ERL SEL-56

SMS-GOES SOLAR SOFT X-RAY MEASUREMENTS
PART I. SMS-1, SMS-2 AND GOES-1 MEASUREMENTS FROM JULY 1, 1974, THROUGH DECEMBER 31, 1976

R. F. Donnelly

Space Environment Laboratory
Boulder, Colorado
May 1981

UNITED STATES DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
James P. Walsh, Acting Administrator

Environmental Research Laboratories
Joseph O. Fletcher, Acting Director

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SMS-GOES SOLAR SOFT X-RAY MEASUREMENTS

Part I. SMS-1, SMS-2 and GOES-1 Measurements from July 1, 1974, through December 31, 1976

by

Richard F. Donnelly
Space Environment Laboratory
NOAA Environmental Research Laboratories
Boulder, Colorado 80303

ABSTRACT

Solar soft X-ray data are presented in daily graphs from July 1, 1974, through December 31, 1976, during the decay of solar cycle 20. Outstanding solar X-ray bursts are shown in detailed two-hour graphs.

1. GENERAL DISCUSSION

1.1 Introduction

The daily figures of X-ray flux presented here were originally developed to aid our research of the long-term variations of the solar soft X-ray flux. They were used to help identify noise and gaps in the data in order to correct hourly and daily average fluxes. However, the graphs are of much broader interest to solar physicists, ionospheric physicists or upper atmospheric scientists who are interested in the solar X-ray flux during a particular period, for example, during particular experiments, X-ray bursts, or the evolution and rotation of particular active regions. Therefore the graphs are presented here for the general information of other scientists. Part II includes similar data from GOES-1, GOES-2, and GOES-3 satellites for the period January 1, 1977, through December 31, 1980.

SMS stands for the NASA Synchronous Meteorological Satellites, which are geostationary spin-stabilized satellites. Two of these satellites have been flown. SMS-1 was launched on May 16, 1974, and the archived X-ray data started July 1, 1974. SMS-2 was launched February 6, 1975, and the archived data started February 10, 1975. After that two satellites were monitored simultaneously, but usually the data from only one of the satellites were processed

for archiving. In some cases where data are missing from the archived data, hourly data from the second satellite were reviewed in order to determine what the solar X-ray flux did during the data gaps. The results are discussed in the text for each month's data. GOES-1 was launched October 16, 1975, and is presented here mainly for the period May 18, 1976, to August 16, 1976. GOES is an acronym for Geostationary Operational Environmental Satellites, which are the NOAA version of the SMS satellites.

The SMS-GOES data presented here are available in greater detail in the form of hourly graphs, microfilm, digital magnetic tapes, and computer printouts from the World Data Center A for Solar Terrestrial Physics, NOAA-EDIS, Boulder, Colorado, 80303. The data presented in this report are useful for an overview of the data and its temporal variations for qualitative and one-to-two-digit quantitative information. These solar X-ray data are used by the Space Environment Laboratory in real time in the Space Environment Services Center (SESC) mainly to detect solar flares to help predict flare-induced particle events and to provide data on the level of solar activity for use in short-term predictions of solar activity. We have previously emphasized the terrestrially important portion of the data, i.e., the larger solar flares and 1-8Å fluxes above 10^{-6} Wm^{-2}. This emphasis still persists in this report by including two-hour graphs of outstanding events, which we have taken as Class X bursts where the maximum $\Phi(1\text{-}8Å) \geq 10^{-4}$ Wm^{-2} (actually $\gtrsim 0.95 \times 10^{-4}$ Wm^{-2}). Class X events cause large daytime D-region ionospheric effects and major shortwave fadeouts (SWF). On the other hand, the preponderance of daily graphs, where the temporal structure of most X-ray bursts is poorly resolved, tends to emphasize the long lasting low X-ray fluxes, which usually are low enough to be terrestrially negligible ($\Phi(1\text{-}8Å) \lesssim 10^{-6}$ Wm^{-2}) but still of interest for solar physics research.

1.2 X-Ray Detectors and Missing Data

The SMS-GOES X-ray detectors have been described elsewhere in detail (Donnelly et al. 1977). Here we will simply describe them as two broadband detectors, one for the 1/2-4Å and the other for the 1-8Å wavelength range. Flux samples are recorded every three seconds. Solar flux measurements are not made during calibrations or when the satellite is in the Earth's shadow,

which occurs only near equinox for at most about an hour and a half. These data losses are reduced by having two satellites spaced in longitude so that these regular outages occur at different times for the two satellites. SMS-GOES solar X-ray data are available in SESC in real time from at least one satellite more than 99% of the time. However, the data presented here occasionally have large gaps of missing data caused by problems with the minicomputer recording systems and with computer processing of the magnetic tapes that reduce the amount of data that is digitally archived.

In order to interpret the X-ray detector output in terms of incident broadband flux, the spectra shape must be estimated. The graphs shown here are based on spectra assumptions discussed in detail by Donnelly et al. (1977). These assumptions were picked to provide accurate flux values when the flux was terrestrially important, i.e., during solar flares and high flux levels. Consequently, the 1/2-4A flux values presented here significantly underestimate the 1/2-4Å flux when the latter is much less than one-tenth of the 1-8A flux, which occurs most of the time. We recommend that the 1/2-4Å flux be used only as a qualitative indicator of temporal variations when $\Phi(1/2\text{-}4\text{Å}) < 0.1 \times \Phi(1\text{-}8\text{Å})$. Interested users can make their own spectra assumptions for low flux conditions and correct the 1/2-4Å flux levels, but the results will be highly model dependent. The 1-8Å flux measurements are much less sensitive to variations in the solar X-ray spectra for the range of variations known to occur. Nevertheless, for 1-8Å flux levels less than 10^{-6} Wm^{-2}, the enclosed graphs underestimate the 1-8Å flux probably by an increasing amount the lower the flux and the smaller the ratio $\Phi(1/2\text{-}4\text{Å})/\Phi(1\text{-}8\alpha)$, perhaps by as much as a factor of two for very low fluxes. For $\Phi(1\text{-}8\text{Å}) > 10^{-6}$ Wm^{-2}, the overall accuracy for the 1-8Å flux has been estimated to be about ± 40% (Donnelly et al., 1977).

1.3 Photoelectron Bias in SMS-1

The solar ultraviolet flux shining on the X-ray ion chambers induces photoelectron ejection, which generates a current that is weakly coupled into the ion chamber current measurements on SMS-1, causing negative telemetry signals when the solar X-ray flux is very low. This problem was greatly reduced on SMS-2 and GOES-1 by revising the circuits to reduce the coupling of the photo-

electron current. A thin absorption window was also added to the GOES-1 and later X-ray telescopes to block the UV radiation. The main effect of this problem is that the 1-8Å flux measurements for SMS-1 greatly underestimate the flux for low flux levels and should only be used qualitatively for $\Phi(1\text{-}8Å) < 10^{-6}$ Wm^{-2} to determine whether the flux is increasing or decreasing. SMS-1 data are presented here only for periods when it was the sole source for data, particularly for July 1, 1974 through February 9, 1975. Of the six SMS-GOES satellites flown to date, SMS-1 produced the poorest quality X-ray data.

The remainder of this report involves monthly presentations of the solar X-ray data. Each monthly report presents the daily graphs of X-ray flux with a brief narrative about the level of solar activity followed by graphs of the outstanding X-class X-ray bursts. Noise has been edited out of the daily graphs. A final section discusses missing data and tries to distinguish between periods of low flux when the data trace is below the graph from periods of missing data.

1.4 Problems at Low Flux Levels for SMS-2 and GOES-1

At flux levels below 10^{-7} Wm^{-2}, concurrent SMS-2 and GOES-1 X-ray measurements show differences that suggest both these sets of measurements suffer from errors. The GOES-1 measurements for such low flux levels sometimes show diurnally recurrent temporal structure that may be caused from interference from energetic magnetospheric particles. SMS-2 data sometimes exhibit similar but less pronounced diurnally recurrent features. There is also some evidence that suggests that SMS-2 data have residual problems with photoelectron effects when the solar X-ray flux is below 10^{-7} Wm^{-2}. At these small flux levels, small solar X-ray bursts can be distinguished in the data and they are observed concurrently from both SMS-2 and GOES-1.

2. GRAPHS OF SMS-GOES SOLAR X-RAY FLUX JULY 1974 - DECEMBER 1976

2.1 July 1974, SMS-1

2.1.1 Solar Activity Overview

The X-ray flux was at its highest and most active levels of the July 1974 - December 1976 period at the commencement of archive X-ray data in July. Numerous flares occurred during the first two weeks and the nonflare background was at about the threshold of terrestrially significant flux, i.e., 10^{-6} Wm^{-2}. The flare activity and background X-ray flux declined on July 11 and remained at very low levels for most of the rest of July and August. See figures 1-6. See also Dodson and Hedeman (p. 129, 1975) for a discussion of this round of activity as a part of the declining phase of solar cycle 20.

2.1.2 Outstanding Events

The X-class X-ray flares are shown in detail in figures 7-17. Most of the X-class X-ray flares of the July 1974 - December 1976 period occurred during the first week of July. Calibrations obscured the peak of the burst of 1355 UT, July 4, 1974. IMP-H data have been used to estimate the peak of this event on July 4 to be about 8×10^{-4} Wm^{-2} (X8) at about 1356 UT (Donnelly and Fritz, 1975). The event at 2144 UT, July 5 was even larger, exceeding the X10 level and causing the X-ray instrument electronics to be pegged at the top of its intensity range. In effect the instrument was saturated. This is the largest X-ray burst in this volume. Based on the slopes before and after saturation, we estimate this event was ~ X12. Slightly larger events occur in the second volume of these data based on the steepness of slope of the X-ray flux before and after saturation and the duration of the event. On the other hand, the second volume is dominated by many X1 bursts, which is expected because the total number of solar X-ray bursts with a peak flux above a given threshold is approximately inversely proportional to the threshold flux. In July 1974, most of the class X bursts were larger than X1. The following

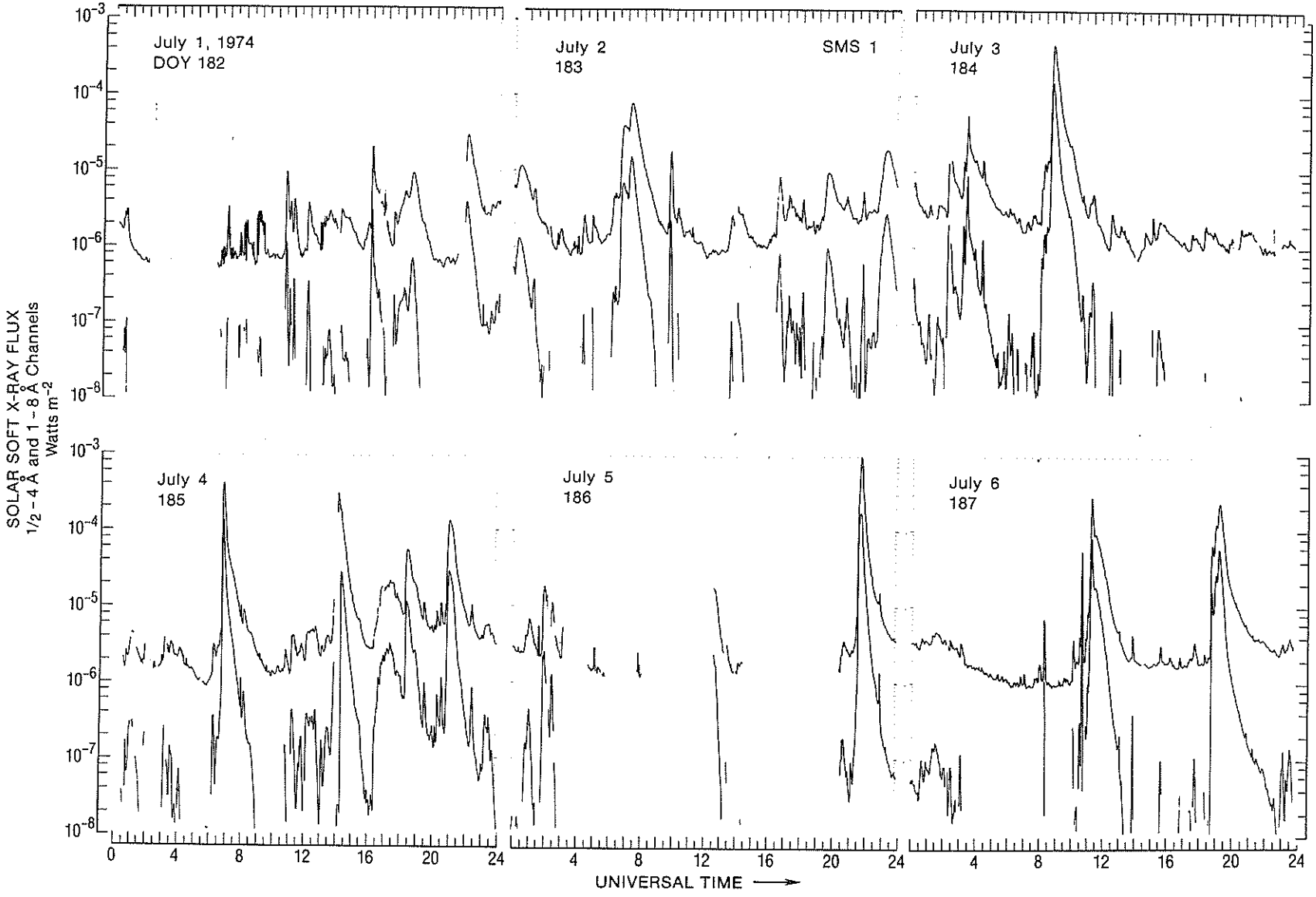


Figure 1. SMS-1 solar X-ray flux for July 1-6, 1974.

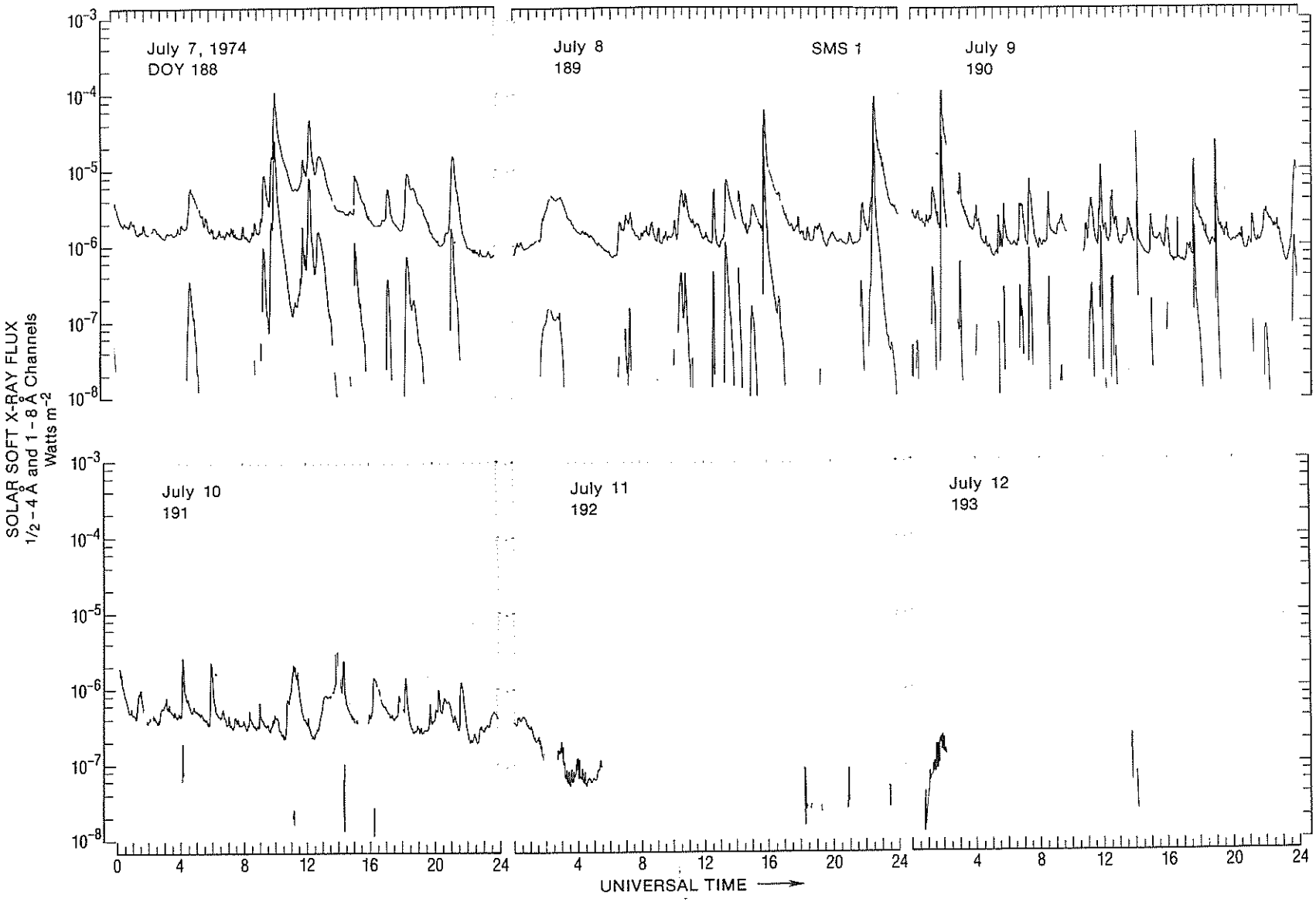


Figure 2. SMS-1 solar X-ray flux for July 7-12, 1974.

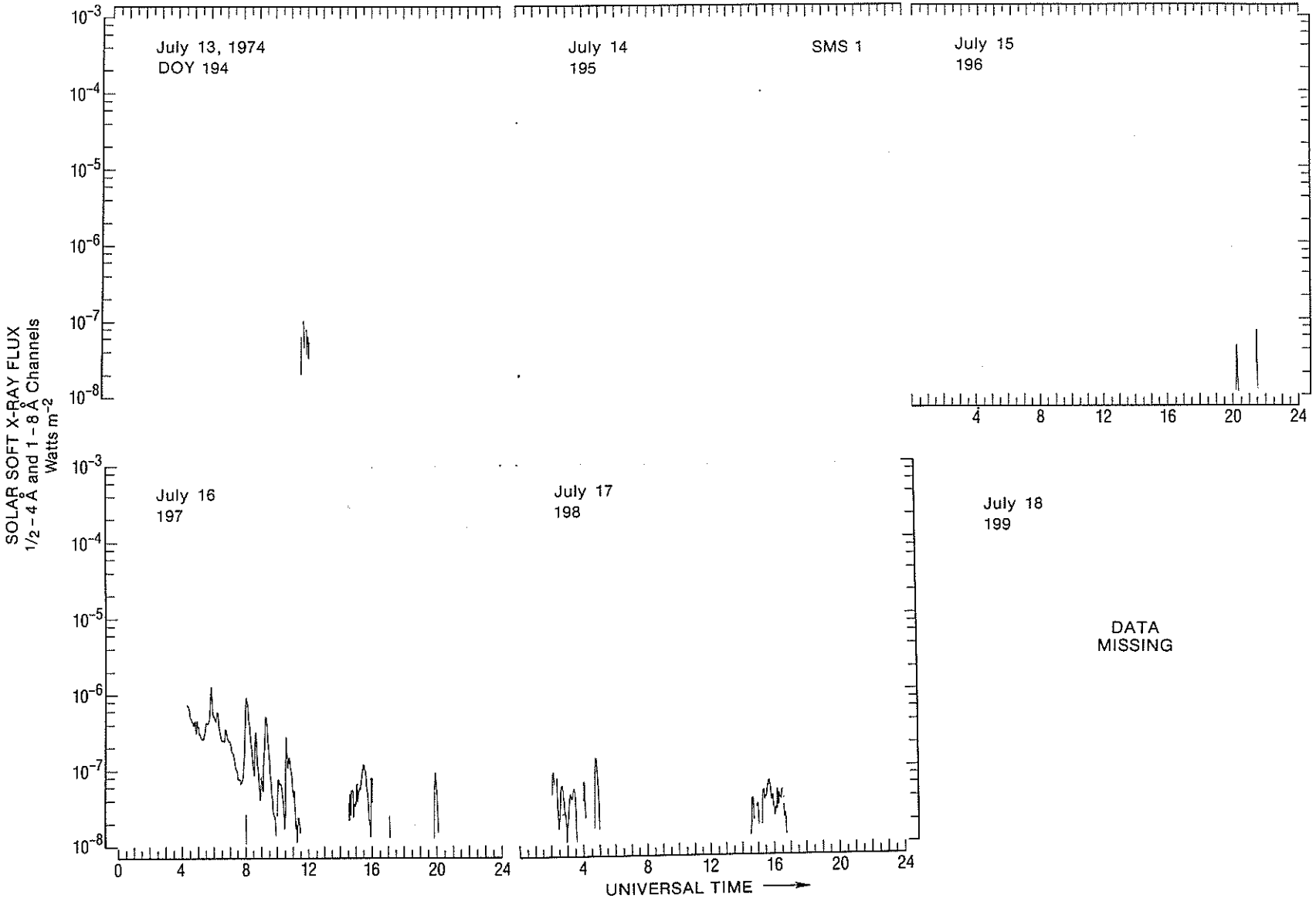


Figure 3. SMS-1 solar X-ray flux for July 13-18, 1974.

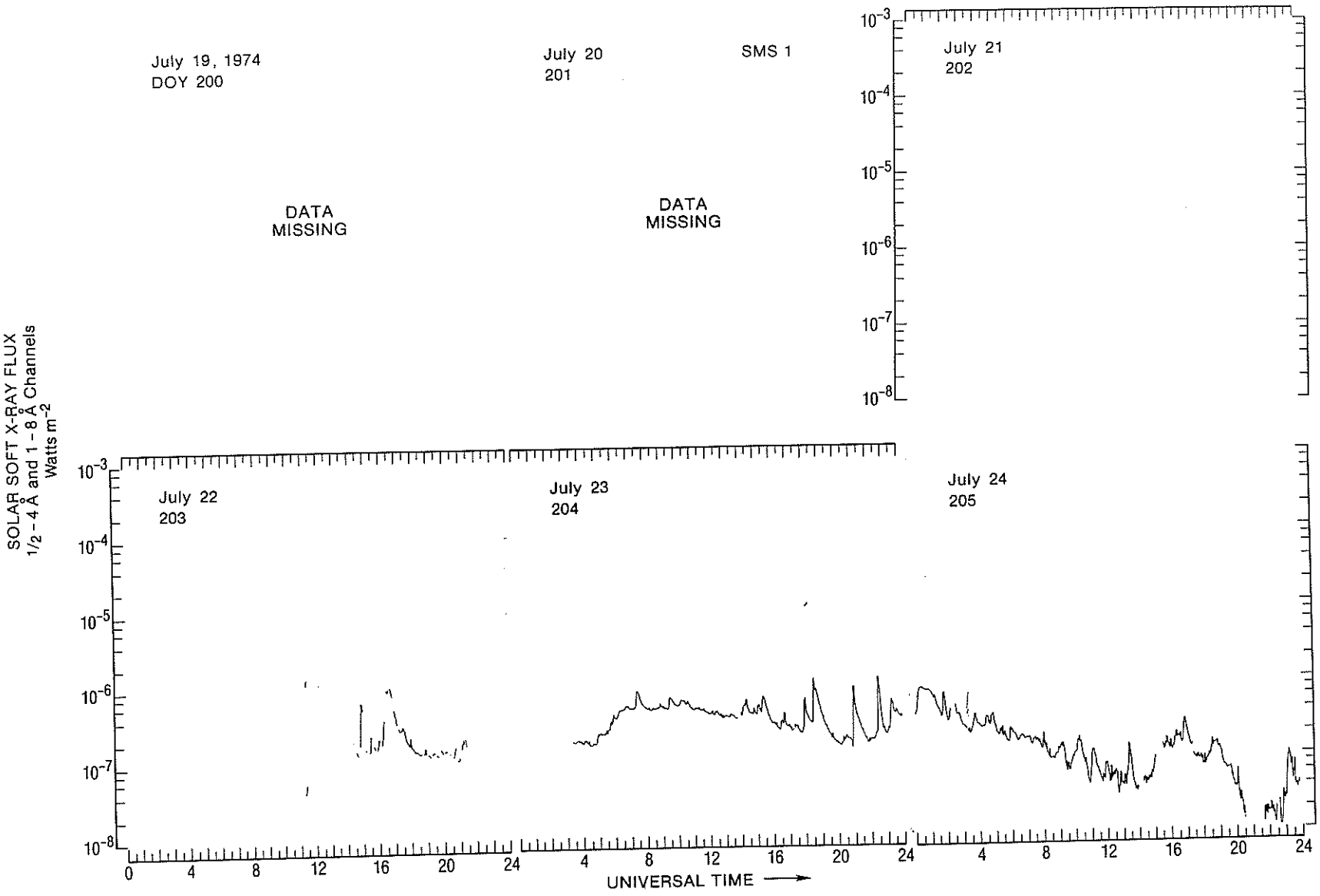


Figure 4. SMS-1 solar X-ray flux for July 19-24, 1974.

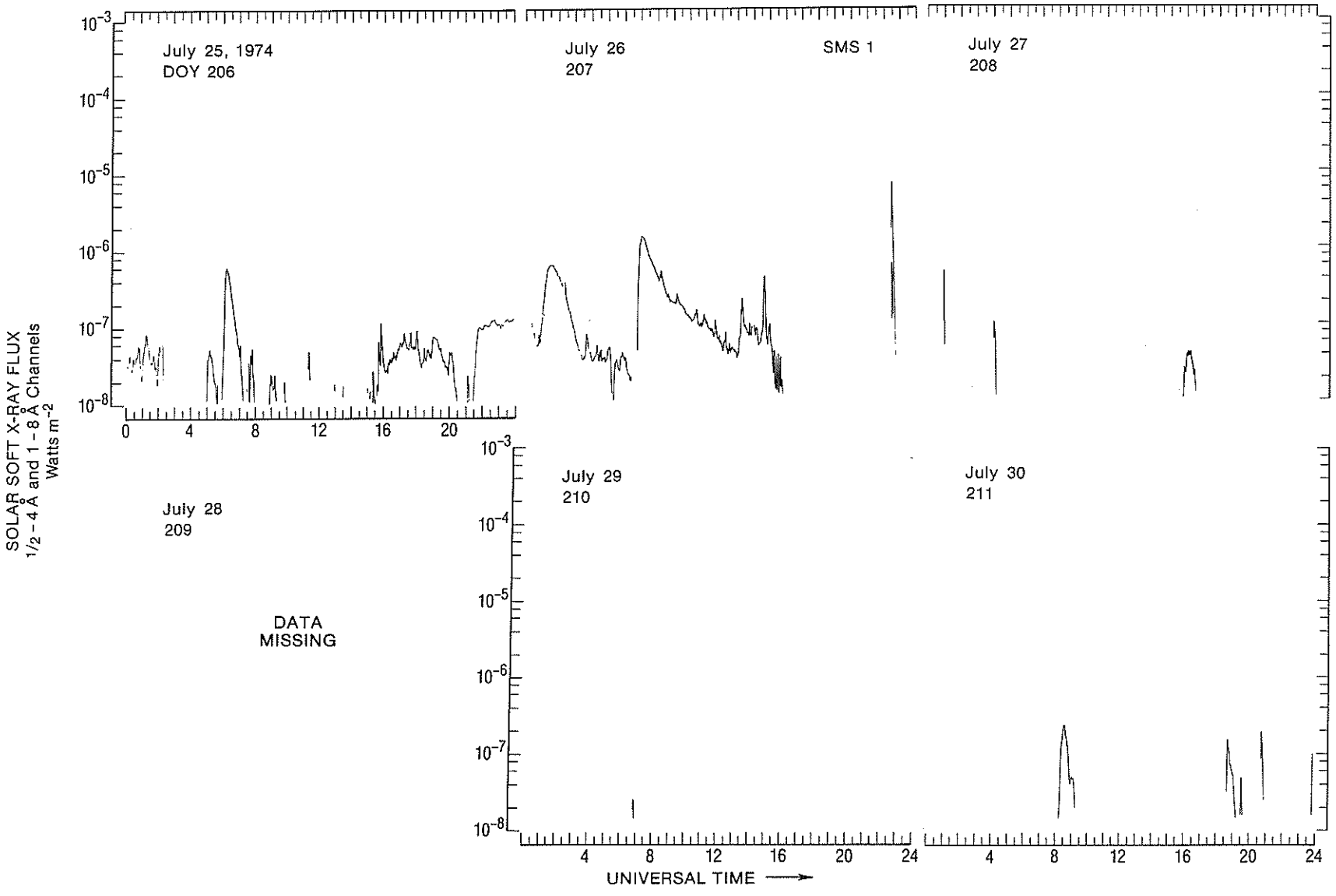


Figure 5. SMS-1 solar X-ray flux for July 25-30, 1974.

sequence occurred in July: X5, X4, ~X8, X1, X2, ~ X12, X3, X2, X1, X1, and X1. This is much more impressive than just a group of X1 bursts. The first ten days of July involved an active region prolific in major X-ray flares. For other studies of solar events during this period, see Kaufmann et al. (1975), Steffen (1975) and Tindo et al. (1976).

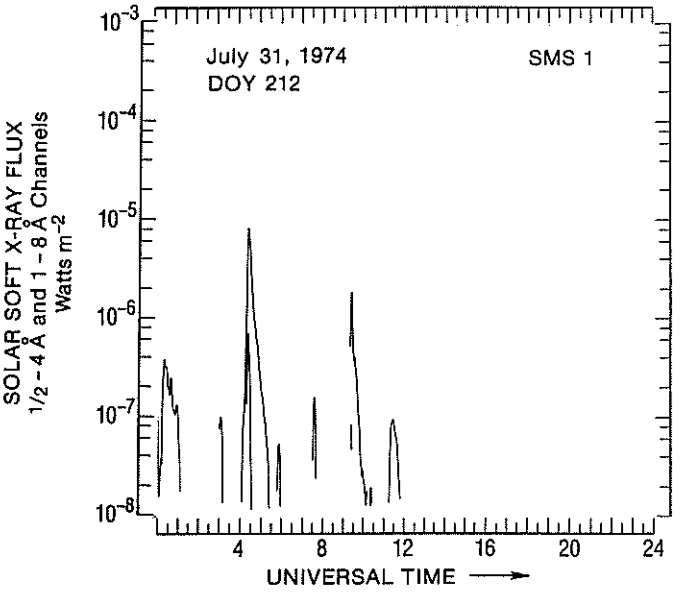


Figure 6. SMS-1 solar X-ray flux for July 31, 1974.

2.1.3 Missing Data

This section is intended to be used only by persons who need information on the X-ray flux at specific times when the graphs alone do not illustrate the X-ray flux clearly. Also remember that when SMS-1 is indicating very low fluxes, the measurements underestimate the solar flux due to an effect from UV-induced photoelectrons. Calibrations occurred twice each day causing about a ten minute loss of data just after 0200 UT and near 1400 UT. On July 1, after the calibrations near 0210 UT and until 0617 UT, recorded data are now missing. Small outages occurred from 2123 to 2149 UT and at other small gaps in the data trace. Note that the small gap between adjacent frames in the figures of daily graphs are not data outages but are only slight separations between the individual daily graphs. Unfortunately large outages occurred on July 5 and the archive data are not available. The X-class flare of 1515 UT shown in figure 11 was retrieved from a computer printout made in July 1974 before the magnetic data recordings were lost. Some of the small fast spikes on July 6 resemble some of the noise bursts that were edited out but those spikes are actually rapid X-ray flares. See for example the M8 X-ray flare of 1038 UT on July 6 in figure 13. The fast spike near 1400 UT appears to be

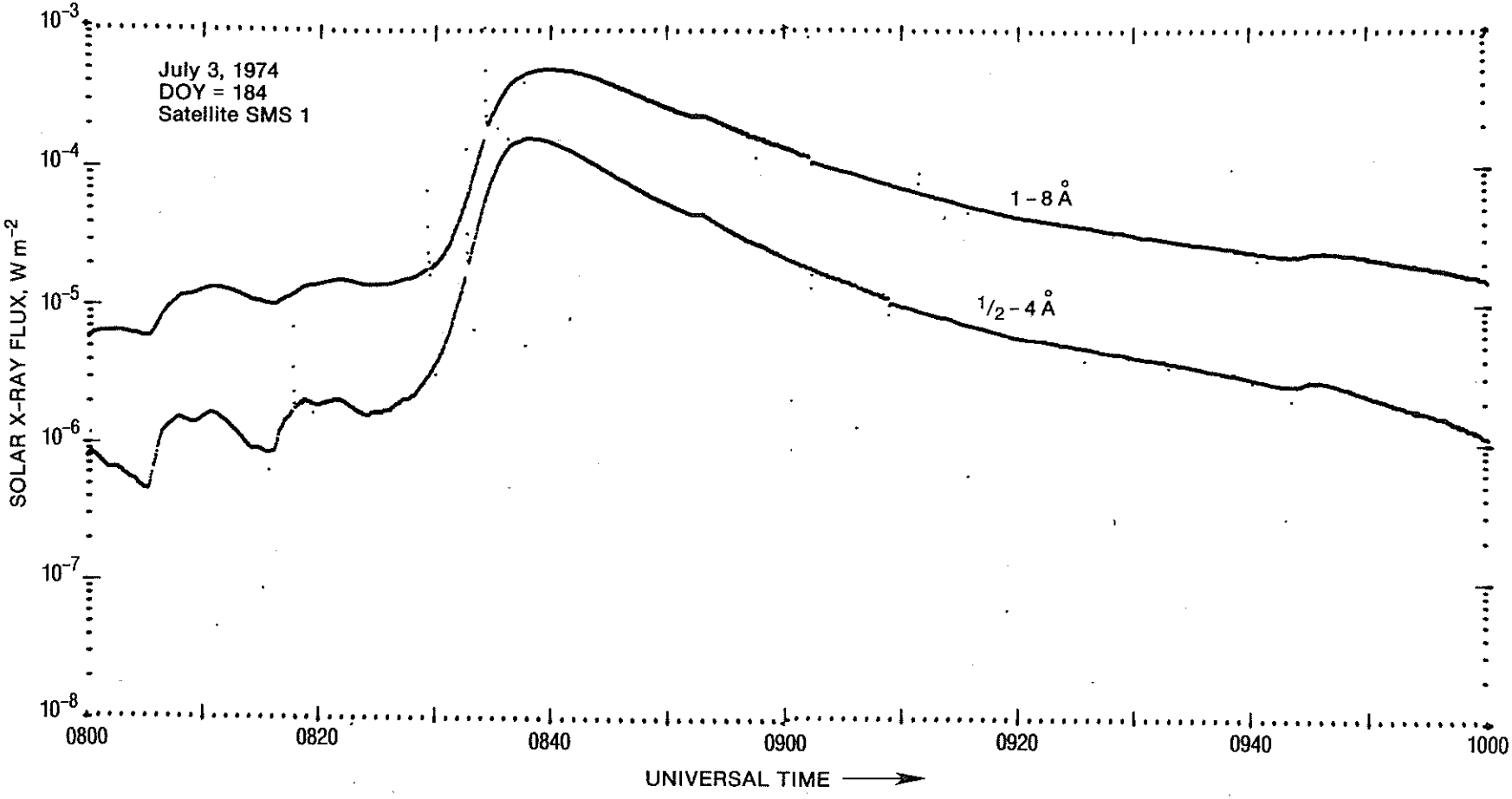


Figure 7. The X5 solar X-ray burst of 0849 UT, July 3, 1974. Note that the small columns of dots near 0829 and 0834 UT in the 1-8Å channel and near 0818 and 0833 UT in the 1/2-4Å channel are caused by instrumentation transients during switching of the electronics amplifier ranges. Similarly, the offsets near 0902 in the 1-8Å channel and 0909 UT in the 1/2-4Å channel are related to downward switching in instrument ranges. See also Steffen (1975).

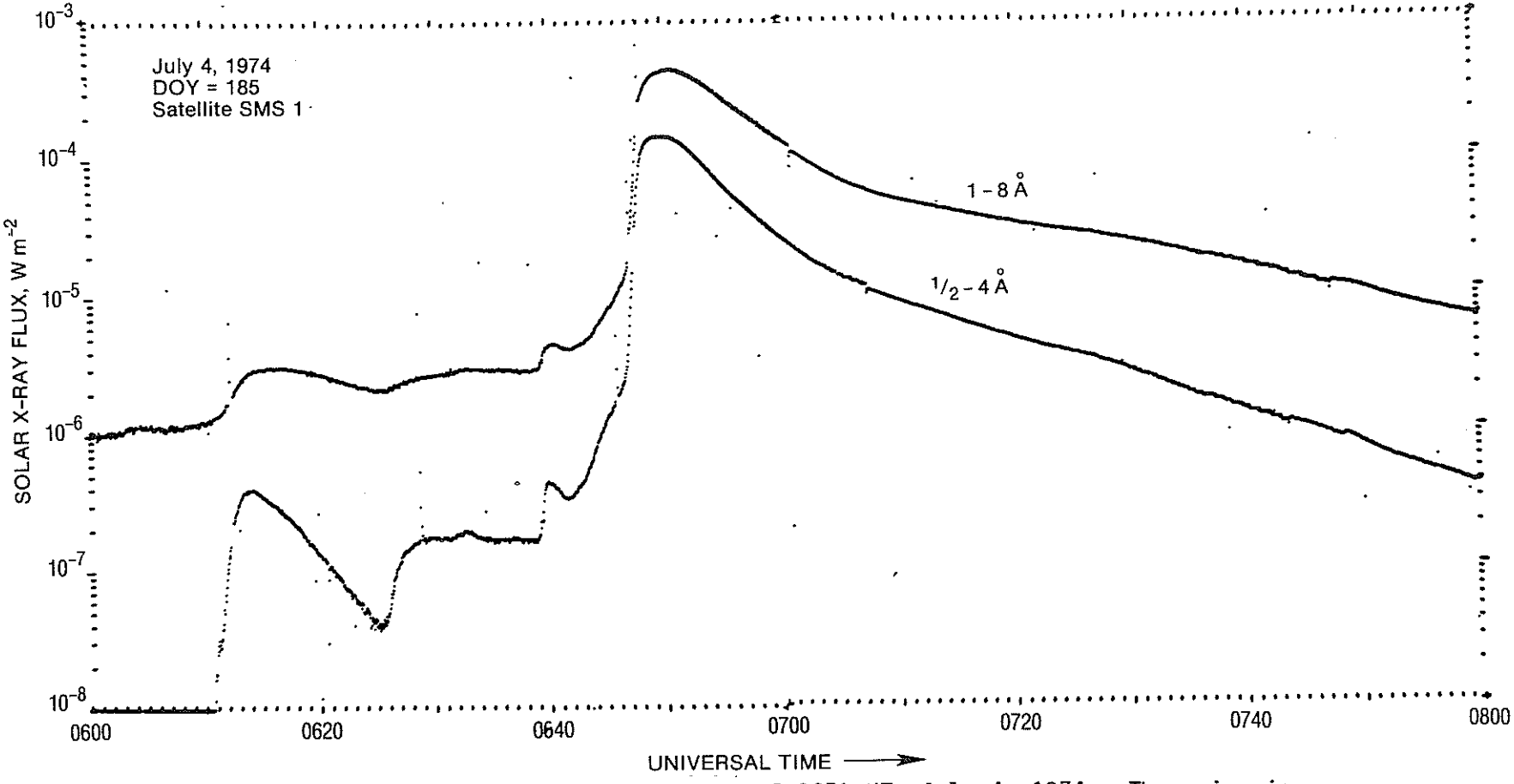


Figure 8. . The X4 solar X-ray burst of 0651 UT, July 4, 1974. The main rise is so fast that individual X-ray measurements every three seconds are separate points. The sequence of rapid-rise points is complicated by two range-change spikes in each channel, which cause gaps in the sequence of dots.

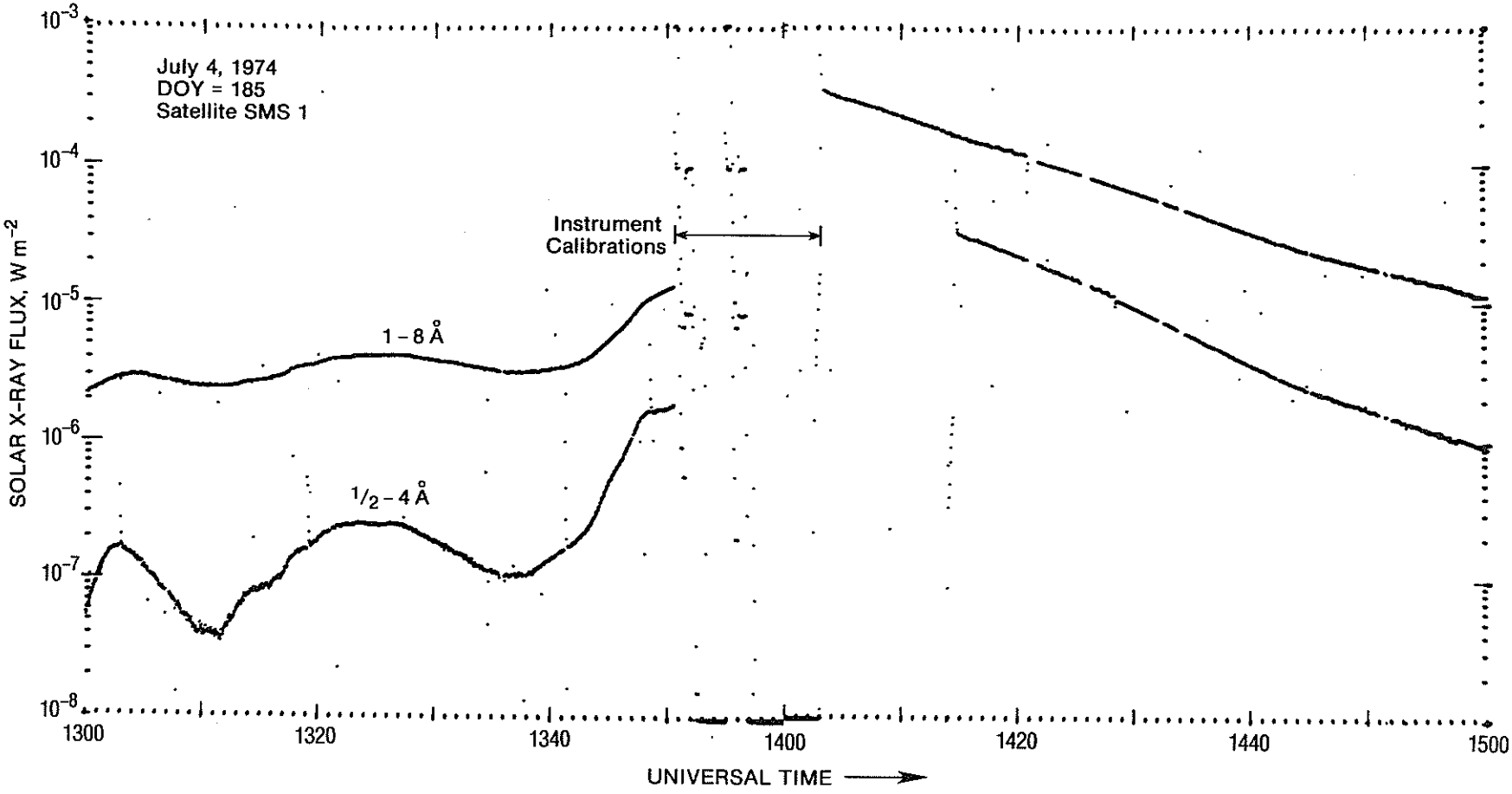


Figure 9. The ~ X8 solar X-ray burst of 1355 UT, July 4, 1974. It would have been nice if calibrations were aborted this time. This solar flare was a white-light flare (Feibelman, 1974). See also Steffen (1975).

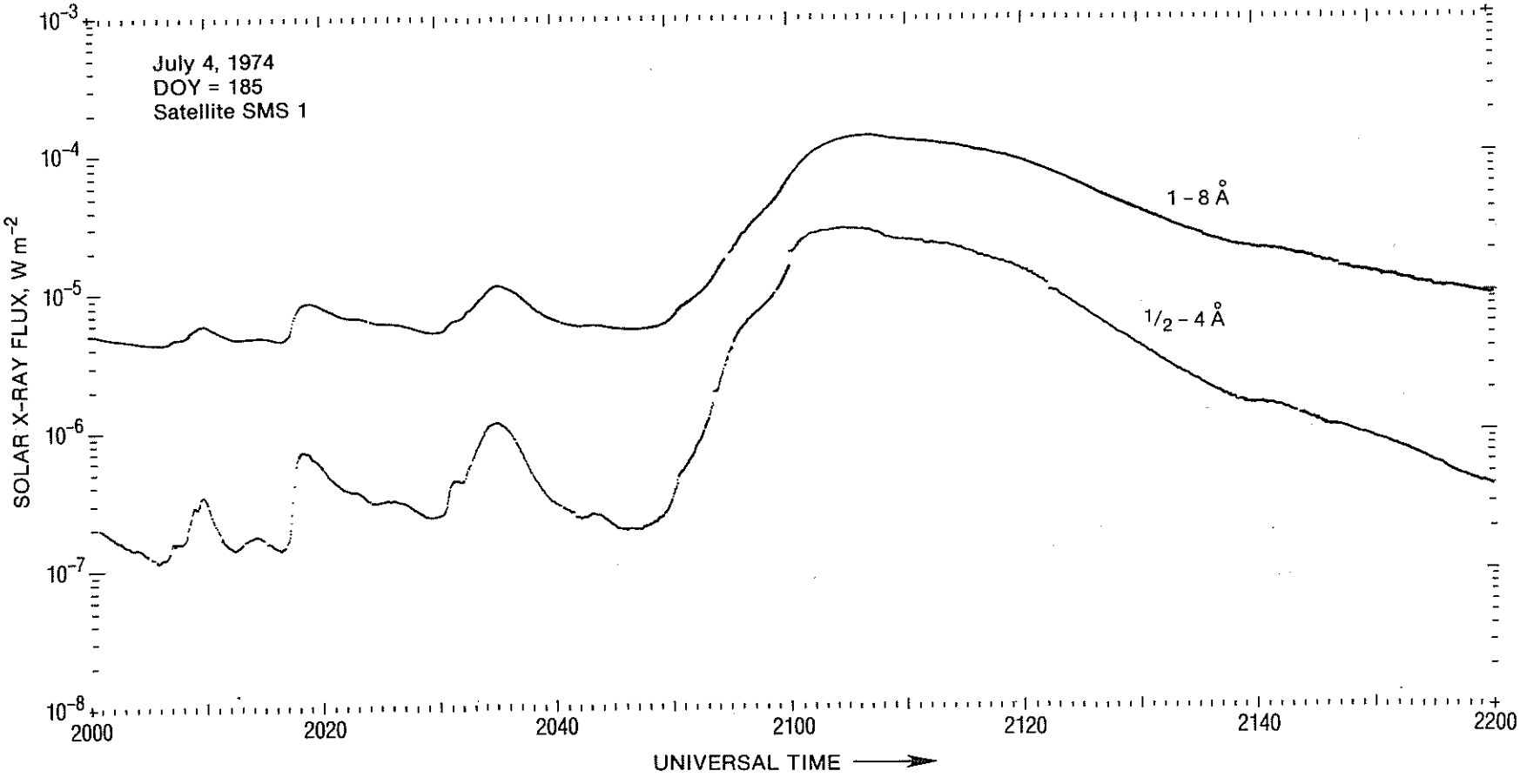


Figure 10. The X1 solar X-ray burst of 2106 UT, July 4, 1974.

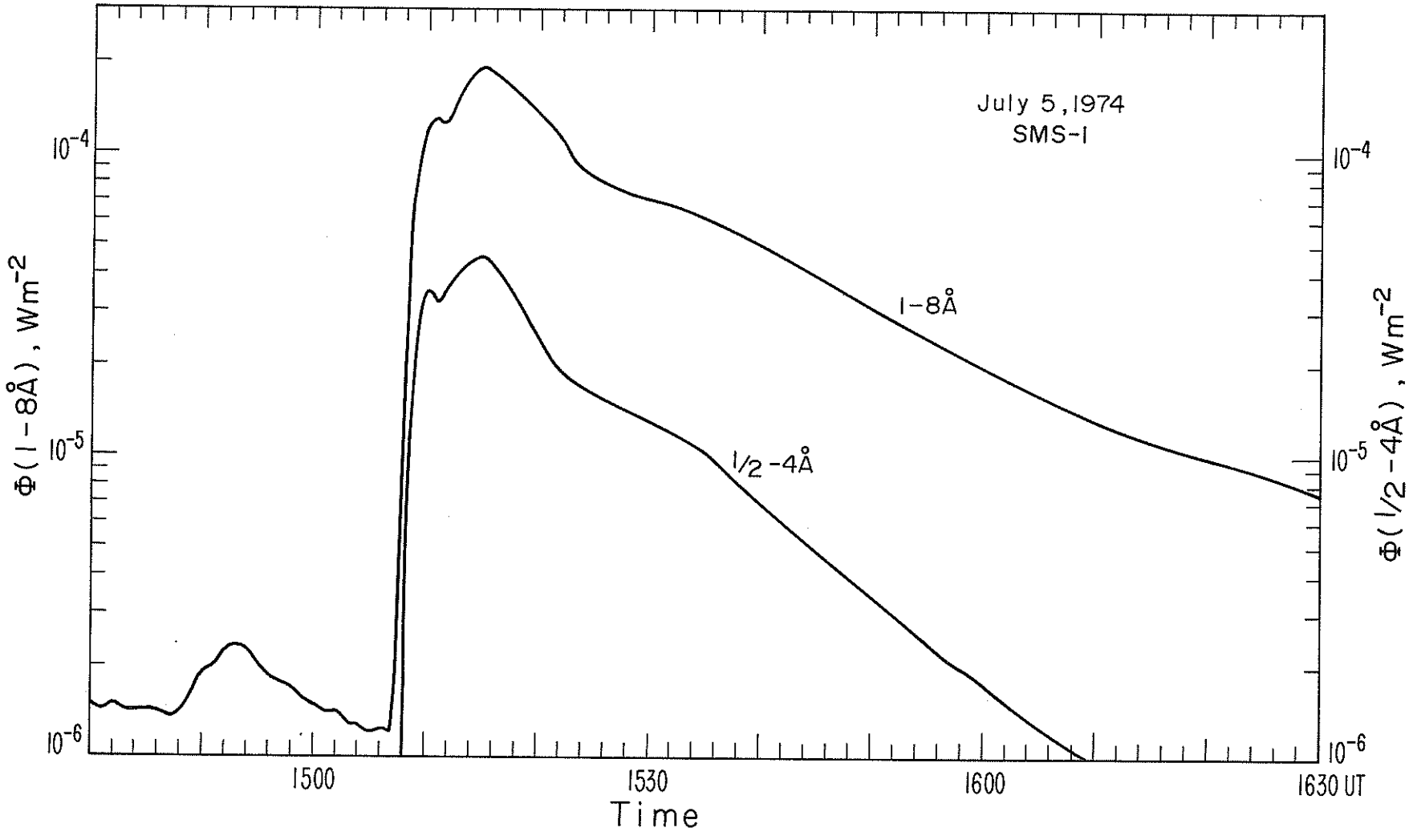


Figure 11. The X2 solar X-ray burst of 1515 UT, July 5, 1974.

76X3250

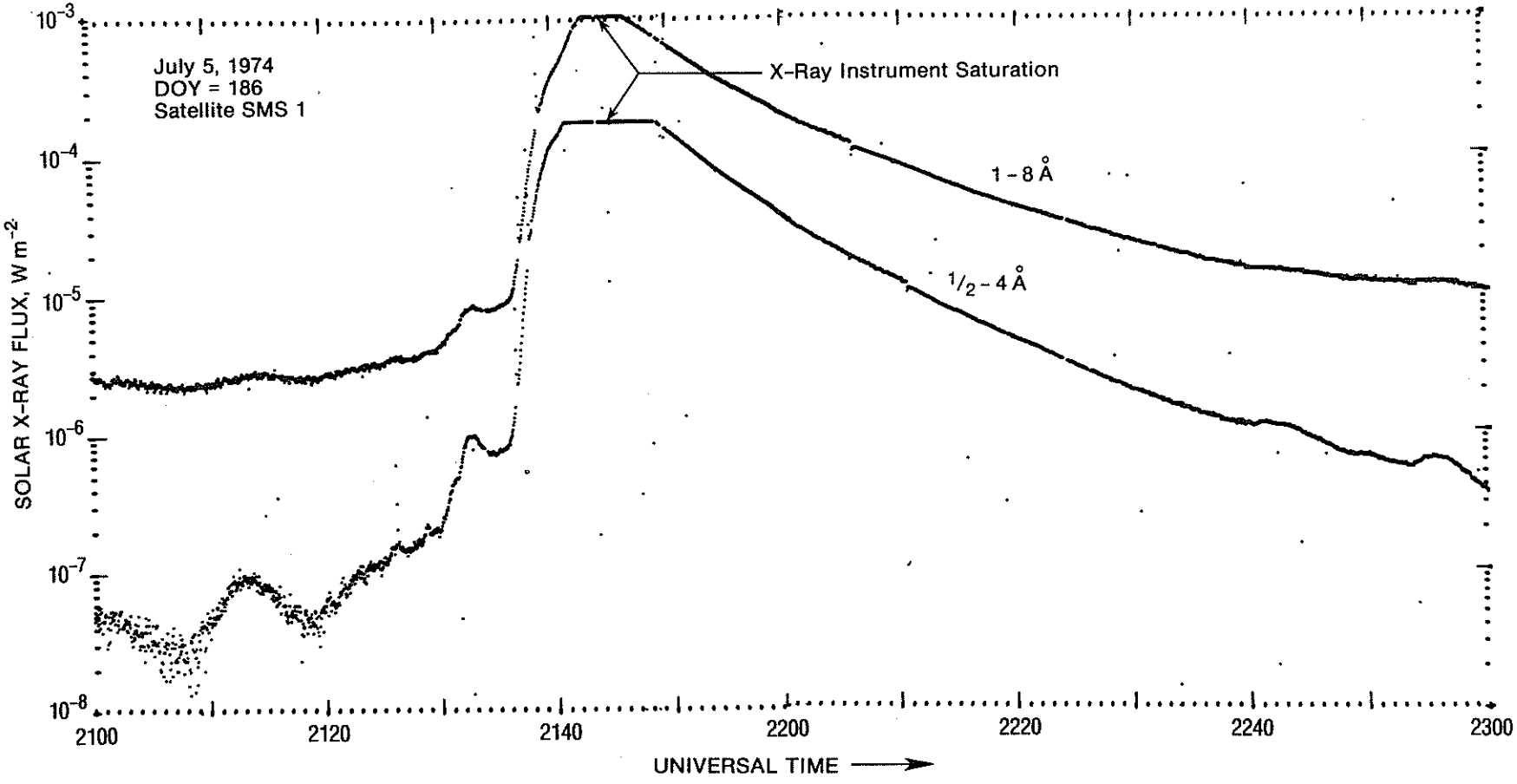


Figure 12. The ~ X12 solar X-ray burst of 2144 UT, July 5, 1974. See also Tindo et al. (1976).

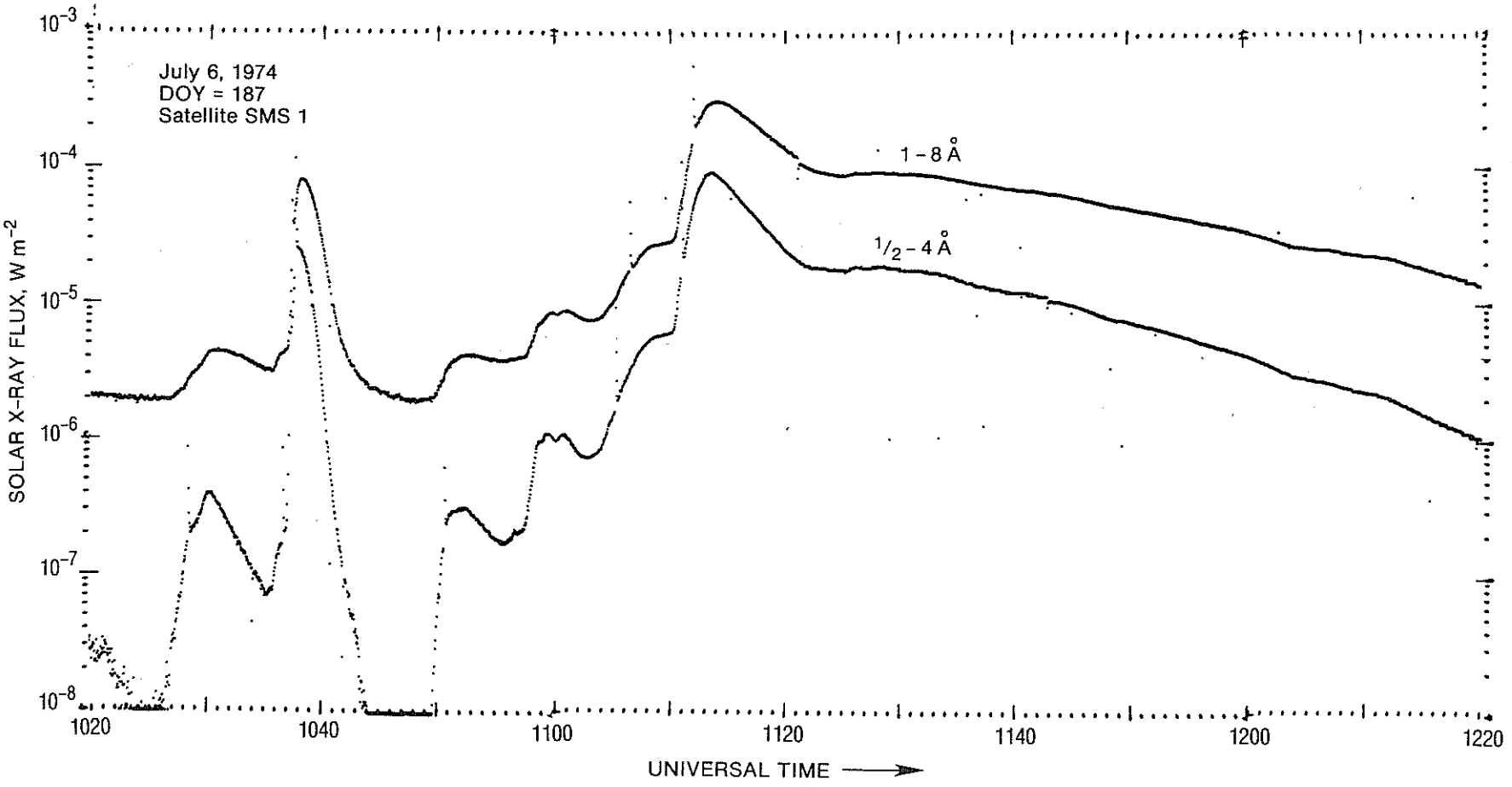


Figure 13. The X3 solar X-ray burst of 1114 UT, July 6, 1974.

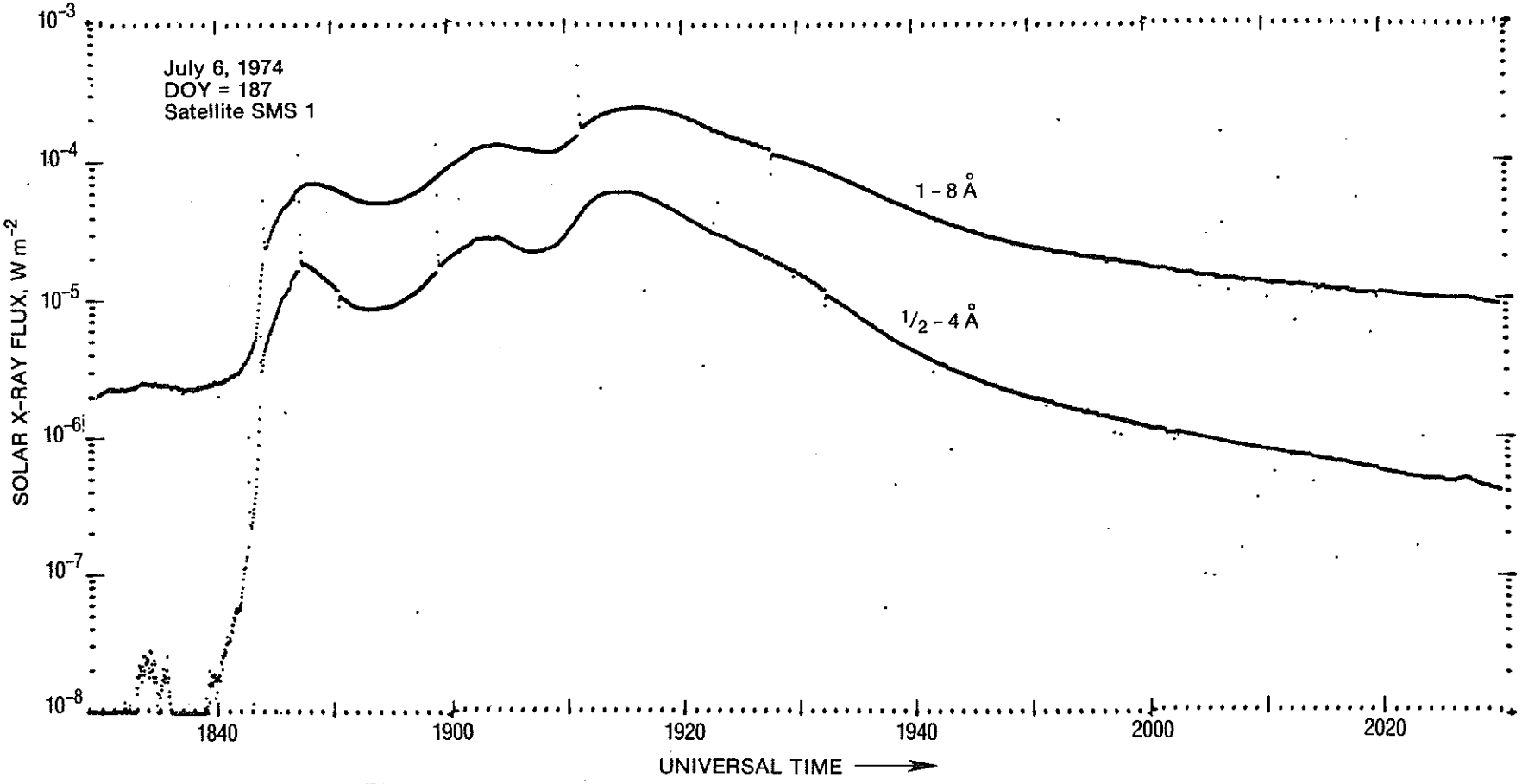


Figure 14. The X2 solar X-ray burst of 1916 UT, July 6, 1974. See also Tindo et al. (1976).

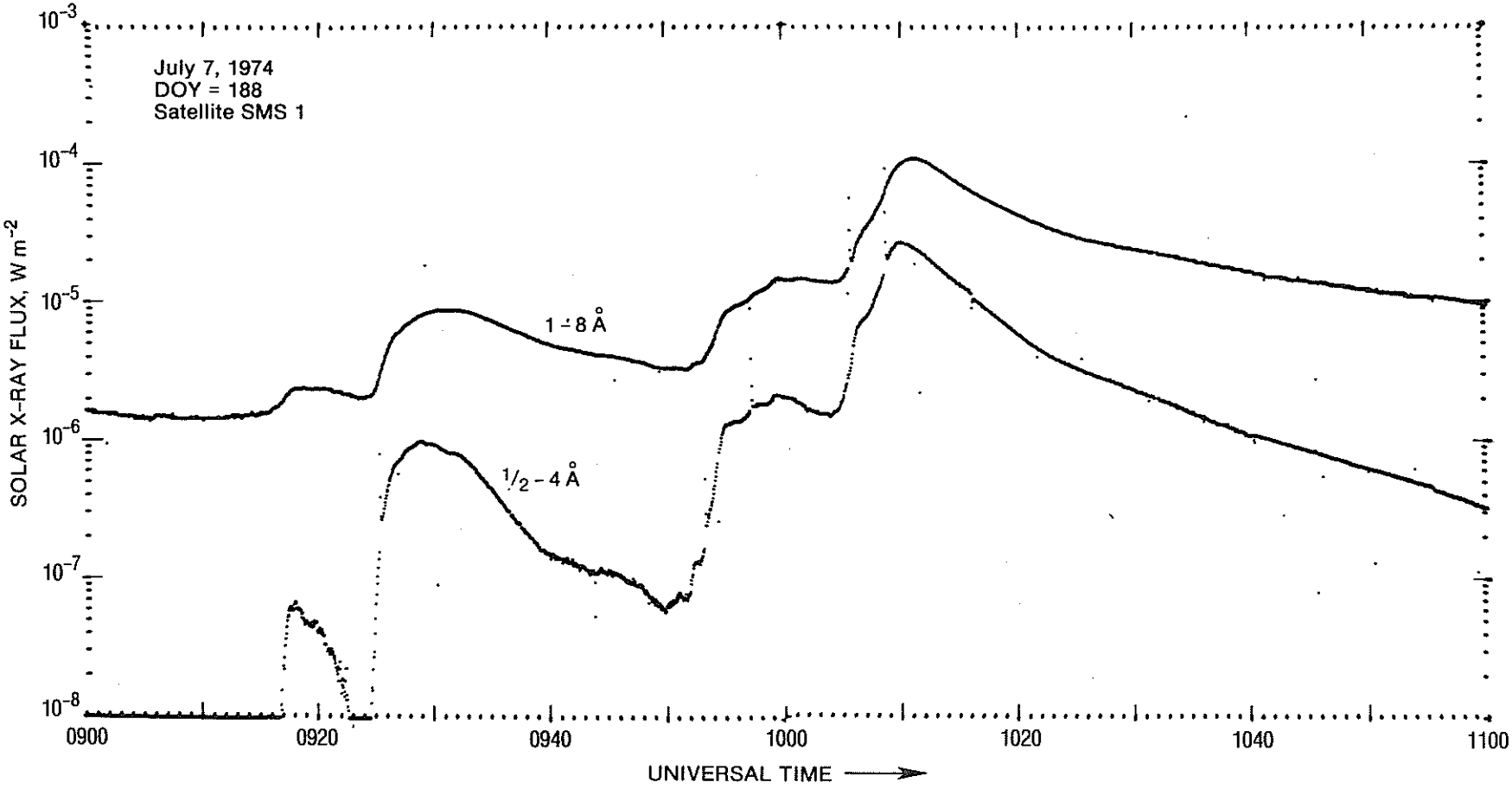


Figure 15. The X1 solar X-ray burst of 1011 UT, July 7, 1974.

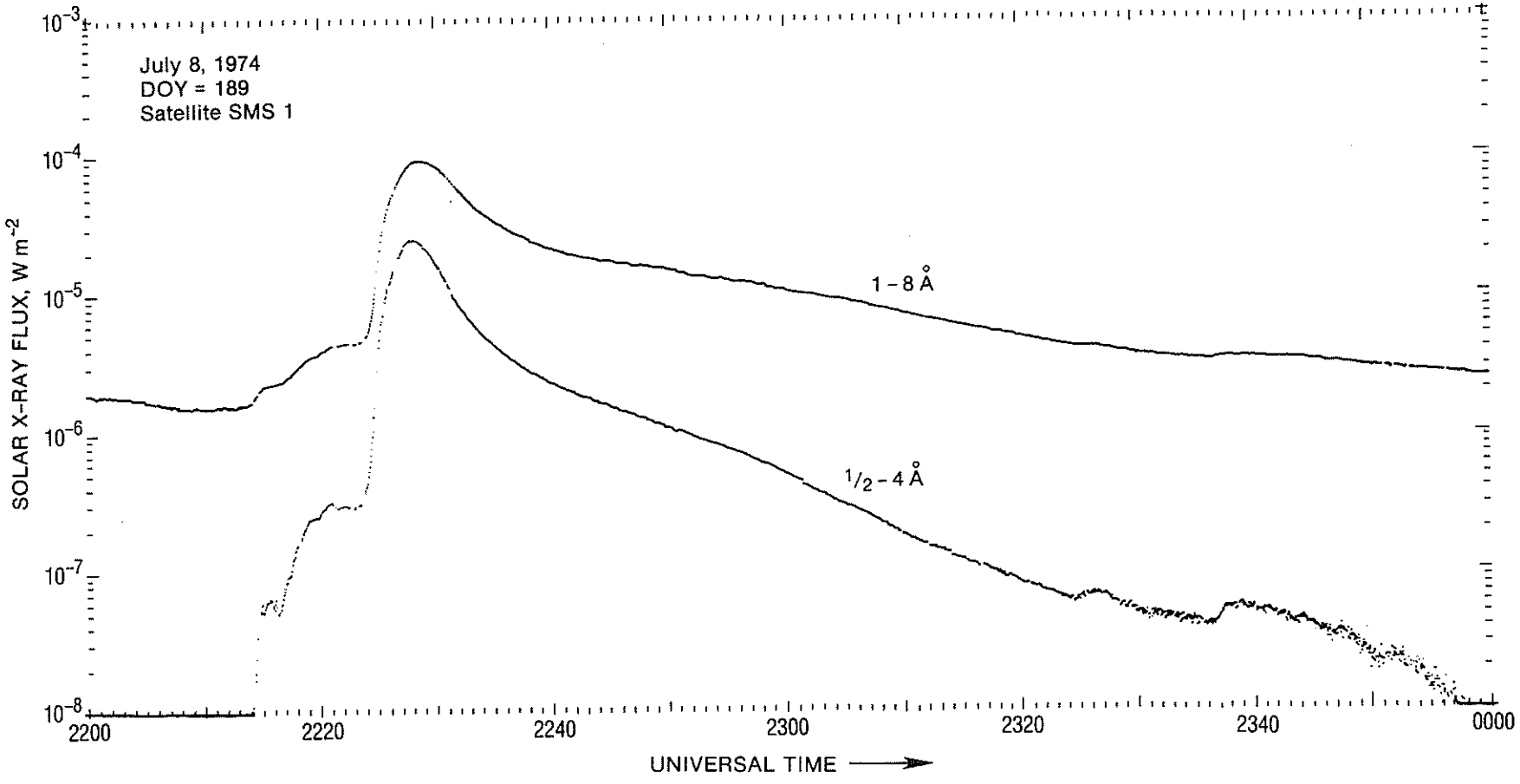


Figure 16. The X1 solar X-ray burst of 2229 UT, July 8, 1974.

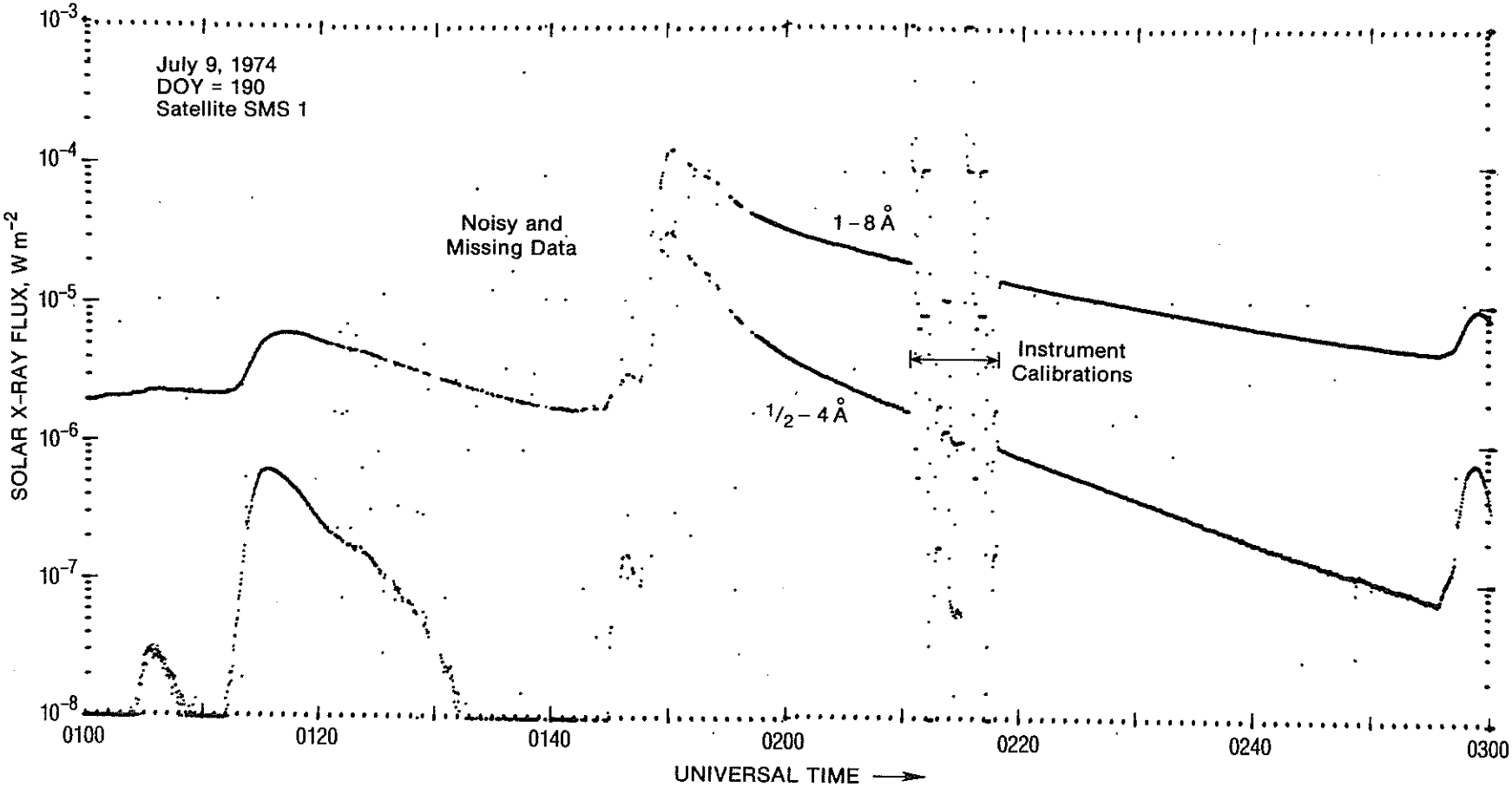


Figure 17. The X1 solar X-ray burst of 0150 UT, July 9, 1974. The data is noisy with numerous missing data and calibrations from 0210-0218 UT.

a fast burst of at least M6 magnitude where the rise and peak were lost due to calibrations.

Several outages are evident from gaps in the data on July 9 and July 10 but on July 11 and later the gaps in the data are indistinguishable from the flux being so low that it is off the bottom of the graph. On July 11, the missing data start at 0530 and continue until 1743 UT, after which the 1-8Å flux is below 10^{-8} Wm^{-2} except for occasional very small fast X-ray flares. Large gaps in the data also occur from 0215 to 1231 UT and 1501 to 2102 UT on July 12. Otherwise the flux is below the graph except for two small fast flares. Similarly, the flux is known to be below the graph on July 13 - 15, except for a few small bursts and except during outages in the following periods: 1206 UT July 13 to 0053 UT July 14; 1629 to 2054 UT, July 14; 2358 UT July 14 to 0121 UT July 15; and 2215 to 0417 UT, July 16. A large outage occurred from 1707 UT July 17 to about 1430 UT July 22. Outages also occurred during 1546 - 2148 UT, July 26th; 1859 UT July 29 to 0233 UT July 30; and 1520 to 1629 UT, July 30. Data exist on July 28 but are below the graph except for three very small flares at 0129, 0203 and 1716 UT. On July 31, the X-ray flux is below the graph except for the bursts shown and for a few scattered outages of a few minutes.

2.2 August 1974, SMS-1

2.2.1 Solar Activity Overview

The X-ray activity was moderate during the first three weeks of August with several class C ($10^{-6} \leq \Phi(1\text{-}8Å) < 10^{-5}$ Wm^{-2}) and one class M event ($10^{-5} \leq \Phi < 10^{-4}$ Wm^{-2}). Then the flux dropped to low levels during the last week of the month. No X-Class flares occurred so no outstanding events are shown.

2.2.2 Missing Data

This section is intended only for users of the X-ray data needing to know the flux at specific times when the graphs are not clear. Calibrations occurred daily just after 0200 UT and near 1400 UT. Data are missing on August 1 during the periods 0000-0005 and 0035 - 1403 UT and during most of

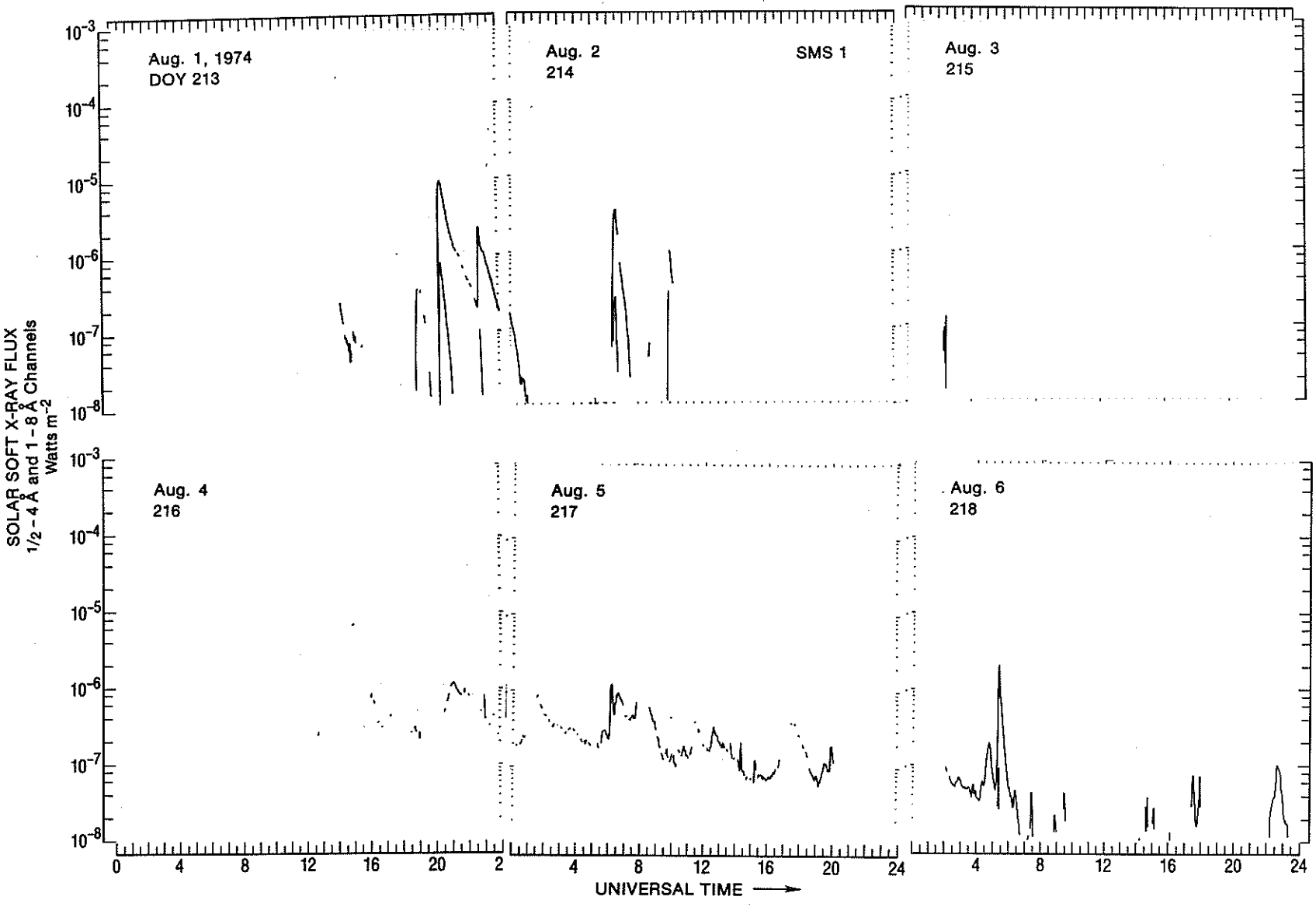


Figure 18. SMS-1 solar X-ray flux for August 1-6, 1974.

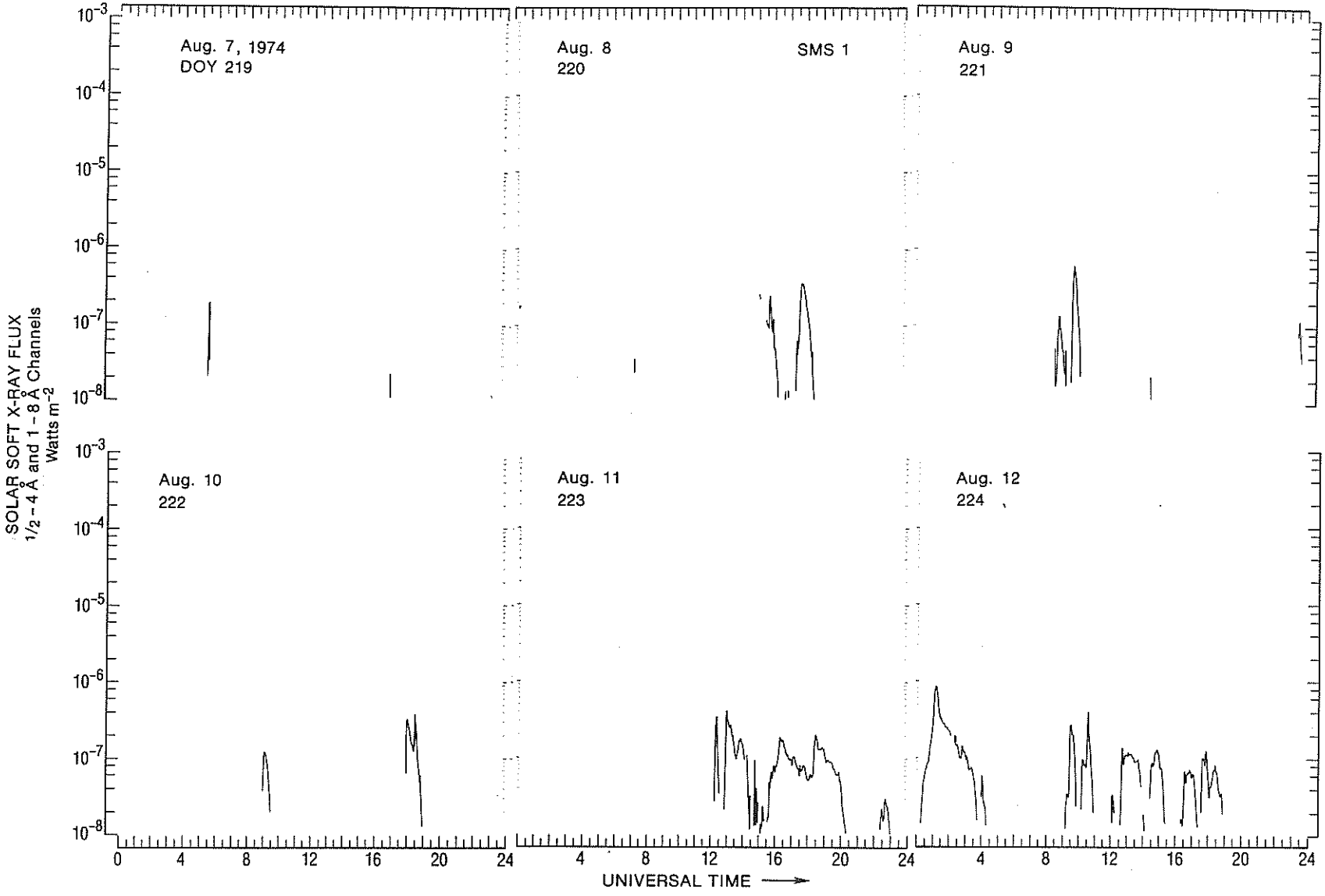


Figure 19. SMS-1 solar X-ray flux for August 7-12, 1974.

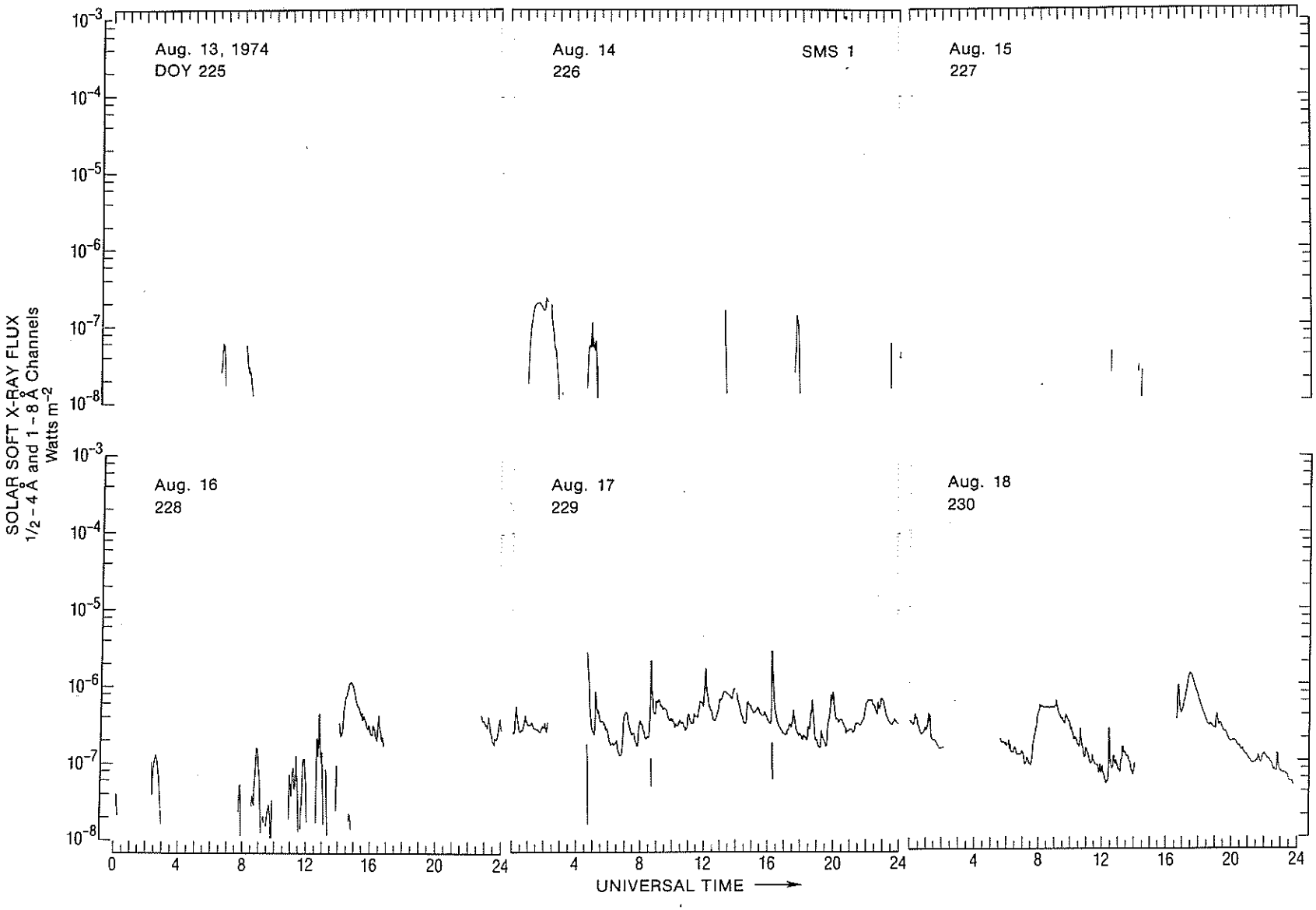


Figure 20. SMS-1 solar X-ray flux for August 13-18, 1974.

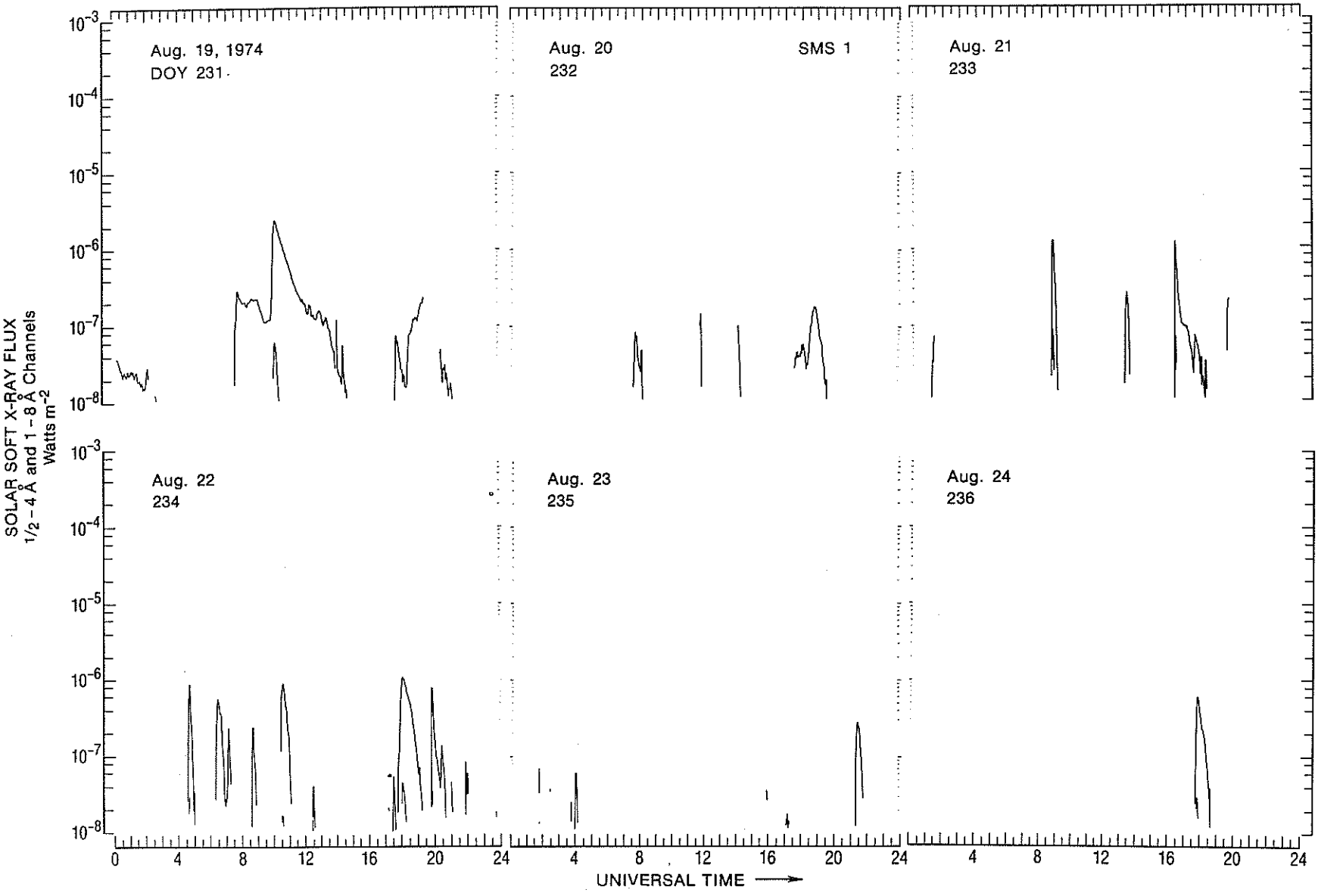


Figure 21. SMS-1 solar X-ray flux for August 19-24, 1974.

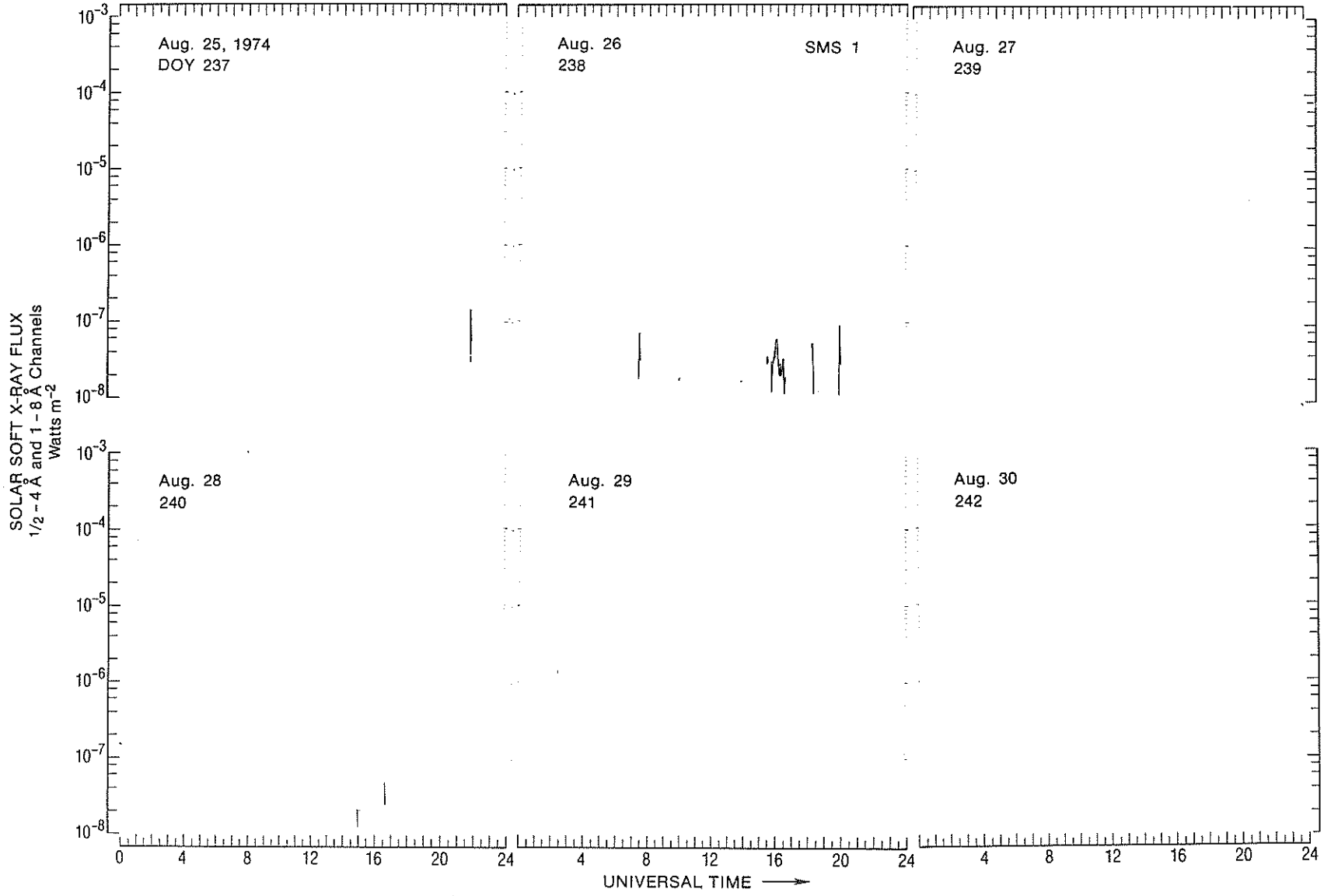


Figure 22. SMS-1 solar X-ray flux for August 25-30, 1974.
See the text for August 31.

the 1500's and 1600's. Then the flux was below the graph during the 1700's and most of the 1800's except for an X-ray microburst near 1900 UT. On August 2, the flux was below the graph between the burst at the start of the day and the C4 X-ray flare after 0600 UT. Outages occurred for about half of the 0800's, and most of the 0900's, 1000's, 1300's and 1700's and all of the 1800 - 2200 UT period; otherwise the flux was below the graph except for the bursts shown. On August 3, the flux was below the graph up to 0336 UT except for two fast microbursts at 0220 and 0225 UT. After 0336 UT, outages occurred until about 0530 UT, August 5, except for the small segments of data shown in the graphs for August 4 and 5. Scattered outages occurred up to 2004 UT on August 5, followed by a complete outage until 0205 UT on August 6, which in turn was followed by the flux being below the graph except for the data showing up to 2019 UT and then an outage up to 2155 UT. Except for one microburst, the flux was below the graph on August 7 from 0000 - 0410 UT, 0513 - 1000 UT and 1400 UT to 0542 UT on August 8. These periods were separated by outages with scattered outages in the 1000's, 1200's and 1300's. The flux is known to be low except for the bursts shown, during the periods: 0633 - 1407 UT, August 8; 1825 UT August 8 to 0838 UT August 9; 1026 - 1550 UT, August 9; and 2152 UT August 9 to 1948 UT on August 12. The small tick near 1700 UT on August 10 is the top of a microburst. Outages occurred during the following periods: 1948 UT August 12 to 0158 UT August 13; 0623 - 0645 and 1505 - 1516 UT, August 15; and 1646 - 2248 UT, on August 16. On August 17-18, there are several gaps in the graphs for which data have since been recovered. During the period 0220 - 0438 UT, the 1-8Å flux is in the range 1 - 7 x 10^{-7} Wm^{-2} until the C3 flare at 0438 UT on August 17. During the gaps of 0219 - 0540 UT and 1410 - 1640 UT on August 18, the 1-8Å flux was in the range 1 - 4 x 10^{-7} Wm^{-2}, except for a fast microburst of 5 x 10^{-7} Wm^{-2} at 1420 UT. These three gaps in the graphs were apparently caused by the calibrations at the start of the gaps. The solar X-ray flux is below the graph except for the traces that are shown and for the following outages: 1923 - 2020 UT, August 19; 2145 - 0347 UT and 2229 - 2241 UT, August 20; 1935 - 2001 UT, August 21; 1520 - 1530, 1621 - 1700, and 1704 - 1710 UT on August 22; and 1112 - 1118 UT, August 24. 1510 - 1533 UT, August 25; 0418 - 1445, 1507 - 1521, 2027 - 2030 and 2149 - 2152 UT, August 27; 1950 - 2049 UT, August 28; scattered outages in the 1900's; 1503 - 1513 and 1601 - 1609 UT, August 29; 0802 - 0813, 0955 - 0959, 1000 - 1026 UT, and scattered outages in the 1100's on August 30.

Although the processing of daily graphs indicated missing data for August 31, the hourly graphs of archived data indicates that the SMS-1 flux measurements are below 10^{-8} Wm^{-2} all day except for outages of 0706 - 0725 and 1010 - 1033 UT.

2.3 September 1974, SMS-1

2.3.1 Solar Activity Overview

The X-ray flux rises from low levels during the first week to high levels during the second and third weeks with C-class flares daily during the period September 5-23, M-class flares on September 9, 13, 18, 22 and 23, and X-class flares on September 10 and 19. The X-ray activity then dropped to low levels again for the period September 24-27. The flux then rose to moderate levels with a flurry of C-class flares on September 29, an M1 flare on the 30, and then dropping below 10^{-7} Wm^{-2} at the end of the month except for occasional microbursts. For discussions of the relation of this round of solar activity with the overall decay of solar cycle 20, see Dodson and Hedeman (p. 129, 1975).

2.3.2 Outstanding Events

Two X2 bursts occurred and are shown in detail in figures 28 and 29. They are not as large in peak flux as some of the July events and there are only two X2 events compared to July's eleven X-class flares. The September events are much longer lasting with much slower decays. These two X-ray events have been discussed by Donnelly and Fritz (1975).

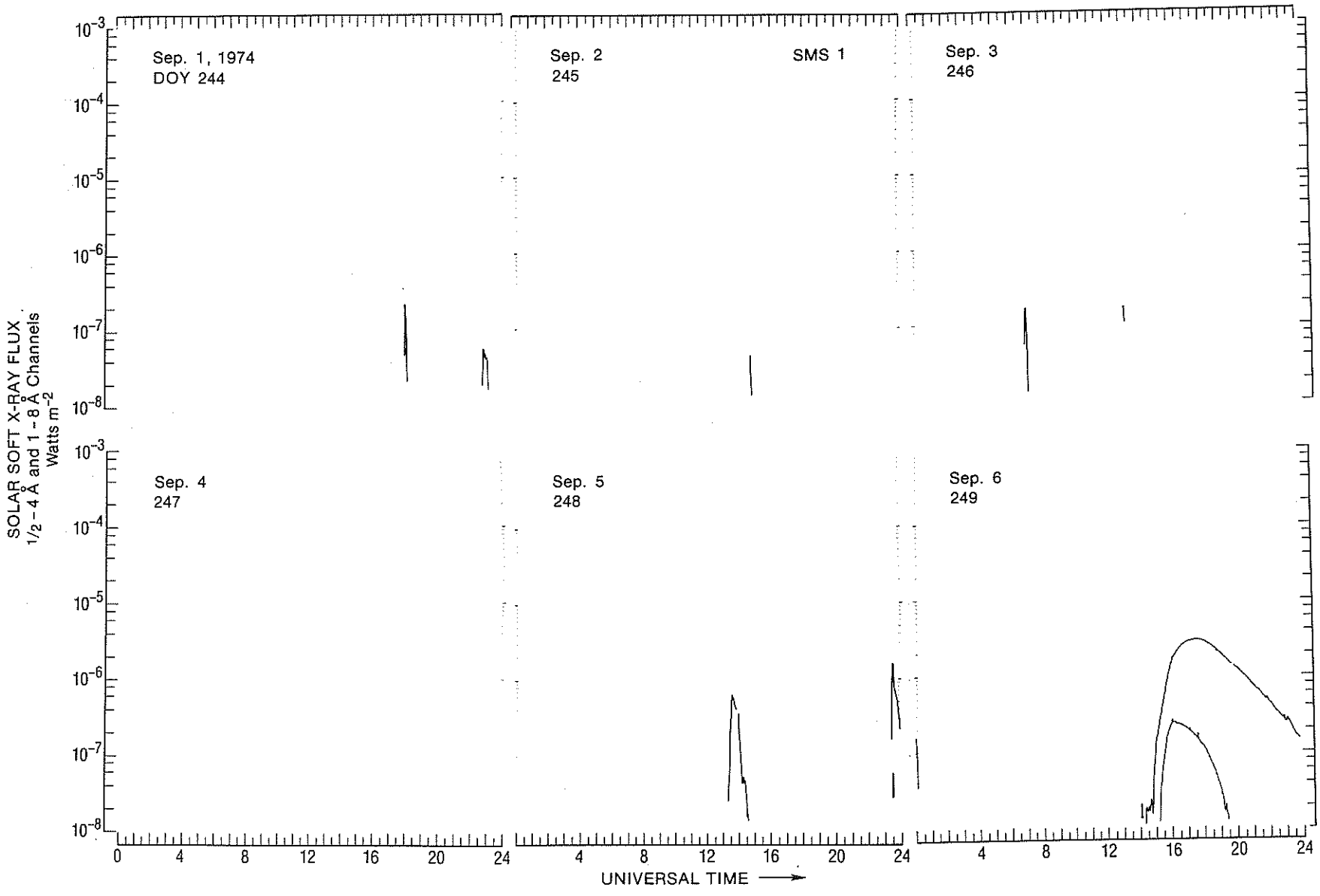
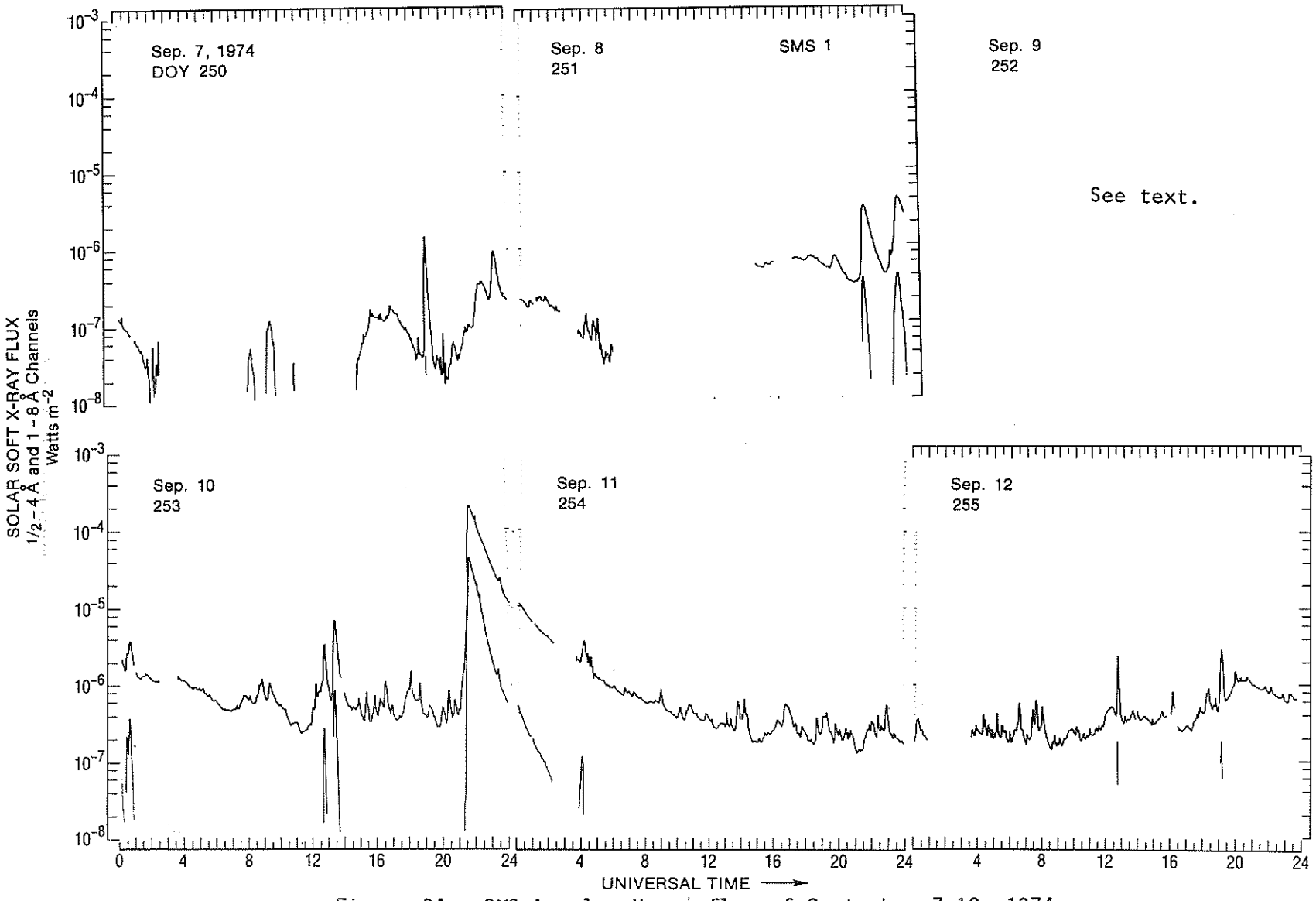


Figure 23. SMS-1 solar X-ray flux of September 1-6, 1974.



See text.

Figure 24. SMS-1 solar X-ray flux of September 7-12, 1974.

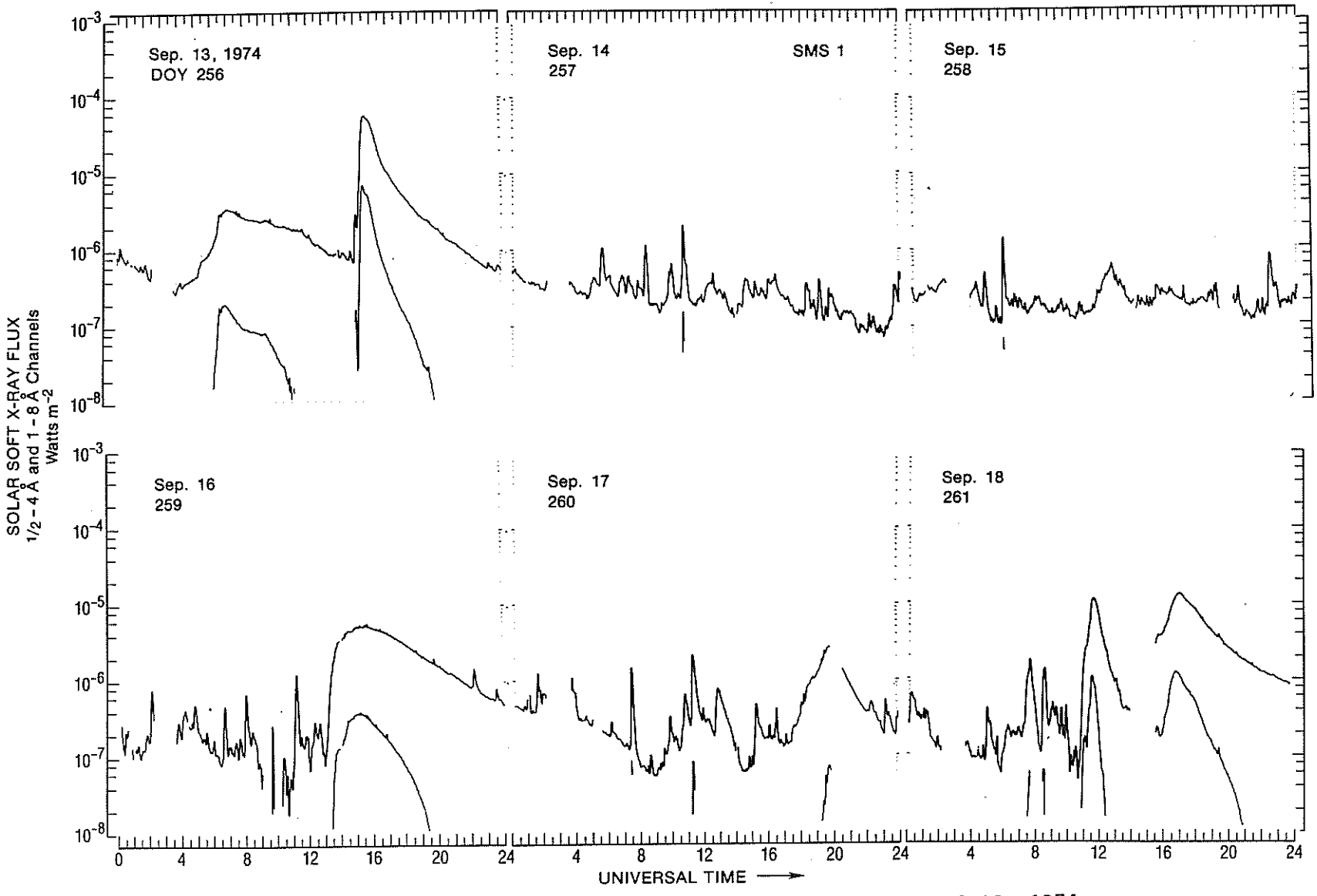


Figure 25. SMS-1 solar X-ray flux of September 13-18, 1974.

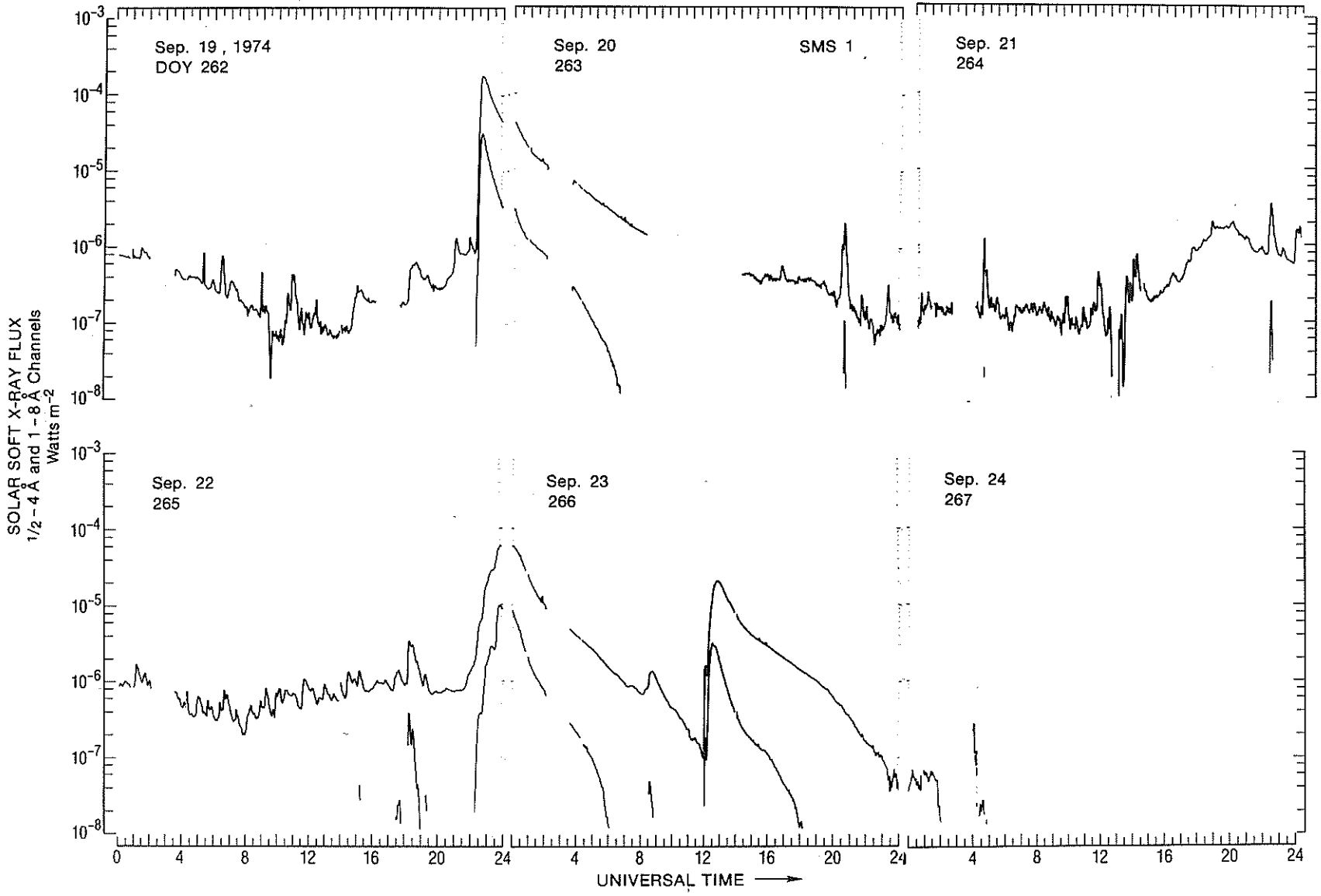


Figure 26. SMS-1 solar X-ray flux of September 19-24, 1974.

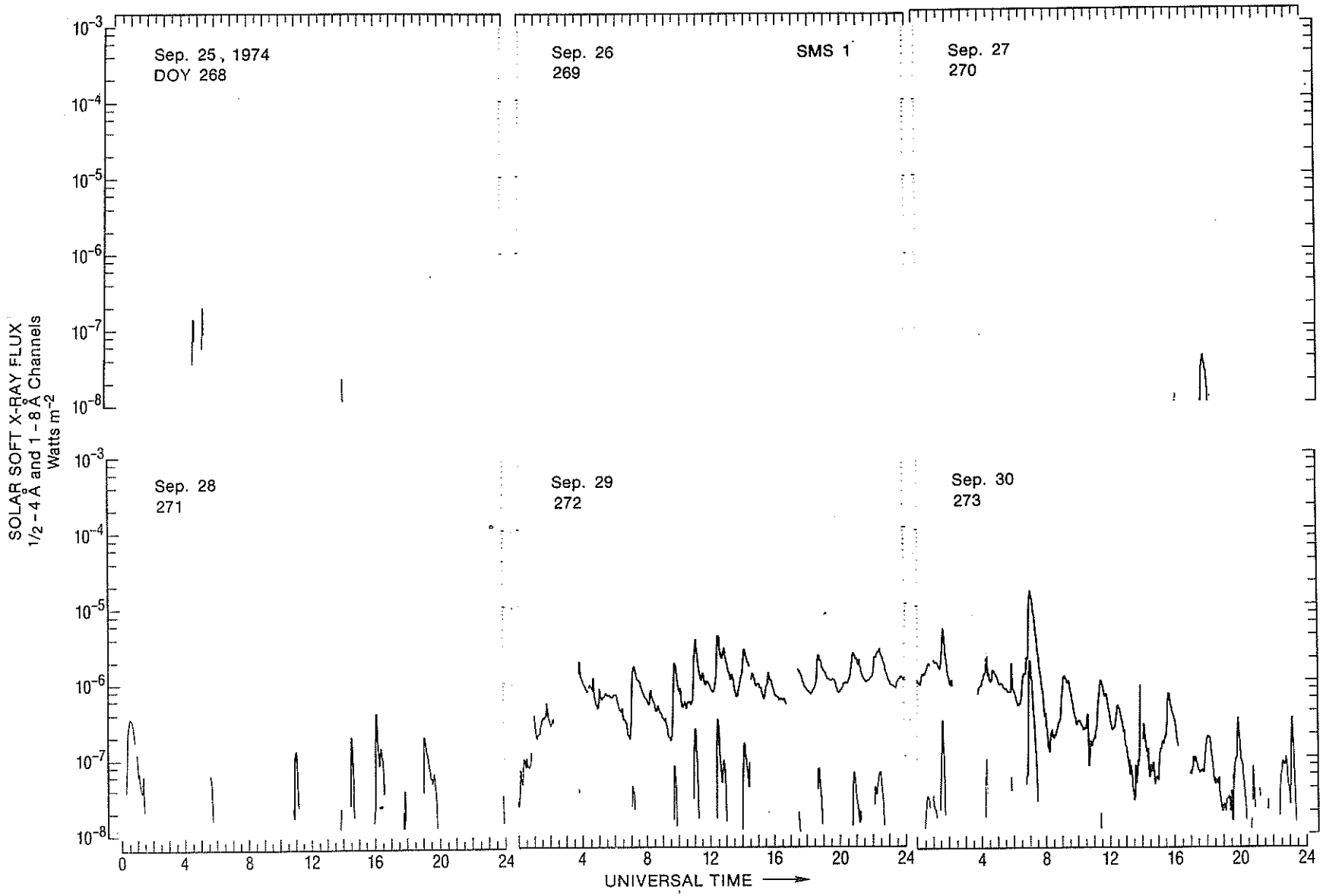


Figure 27. SMS-1 solar X-ray flux of September 25-30, 1974.

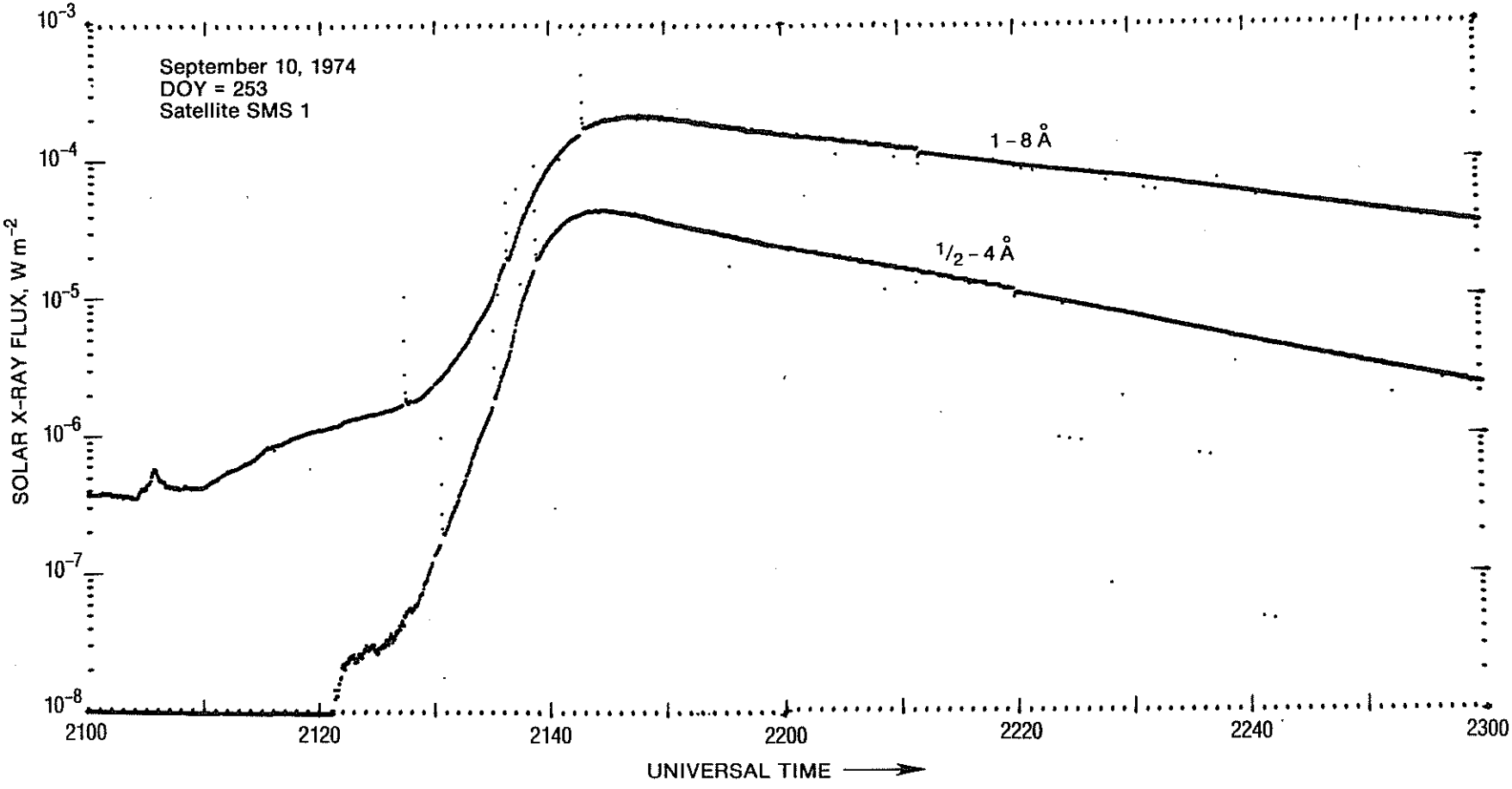


Figure 28. The X2 solar X-ray burst of 2147, UT, September 10, 1974.

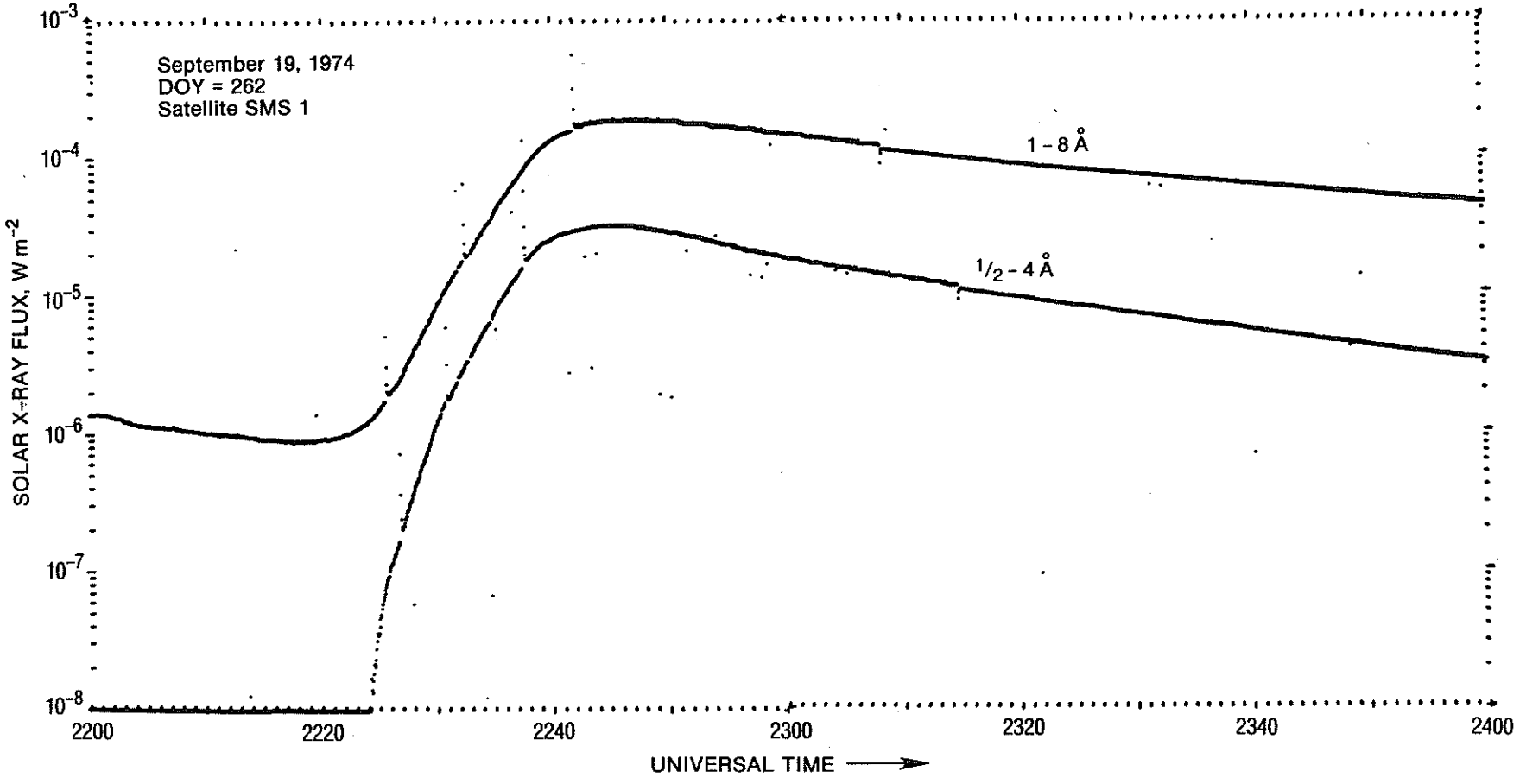


Figure 29. The X2 solar X-ray burst of 2245 UT, September 19, 1974.

2.3.3 Missing Data

This section is intended to be used only by persons who need information about the X-ray flux at specific times when the graphs do not illustrate the X-rays clearly. Calibrations occur daily just before 0100 (0200 UT for September 1-6) and 1400 UT. Outages in solar flux measurements caused by the satellite passing into the Earth's shadow occur daily near equinox for about an hour and a half near 0300 UT. Otherwise the flux is as shown, or below the graph, except for data outages during the following periods: scattered small outages 2210 - 2245 UT, September 4; 0237 - 0331, 0544 - 1440 and 1550 - 1700 UT, September 8; 0051 - 0333, 1547 - 1603, and 1616 - 1626 UT, September 12; 1912 - 2003 UT, September 15; 0032 - 0048 UT, September 16; 0453 - 0532 and 1950 - 2035 UT, September 17; 1610 - 1740 UT, September 19; 0815 - 1410 UT, September 20; 2151 - 2210 UT, September 24; 1422 - 1442 UT, September 25; 1639 - 1724 UT, September 29; and 1610 - 1649 UT, September 30. Although the graph for September 9 is missing, X-ray data have been found that show first a continuation of the C-class flare at the end of September 8, with flux in the 10^{-6} to 10^{-7} Wm^{-2} range until 0230 UT when a data outage was caused by the satellite passing into the Earth's shadow until 0332 UT. Then C1 flares occurred at about 0342, 1000 and 1701 UT, an M1 flare at 1729 UT, C2 at 2024 UT, and C5 flares at 2132 and 2350 UT, September 9.

2.4 October 1974, SMS-1

2.4.1 Solar Activity Overview

The X-ray flux was generally below 10^{-7} Wm^{-2} on October 1 and 2, except for scattered microbursts and one C1 flare on October 1. On October 3, the apparent non-flare background flux rose to about 5×10^{-7} Wm^{-2} for the period October 4-6, and then rose to a high background level of about 10^{-6} Wm^{-2} (C1 level) for October 8-15, followed by a slow decline at moderate levels through October 19. Then the flux dropped to very low levels for the rest of the month except for a rise to moderate levels on October 31. Numerous small flares occurred throughout the month, but less than two dozen M-class flares occurred. No outstanding X-class flares were observed by SMS-1, but

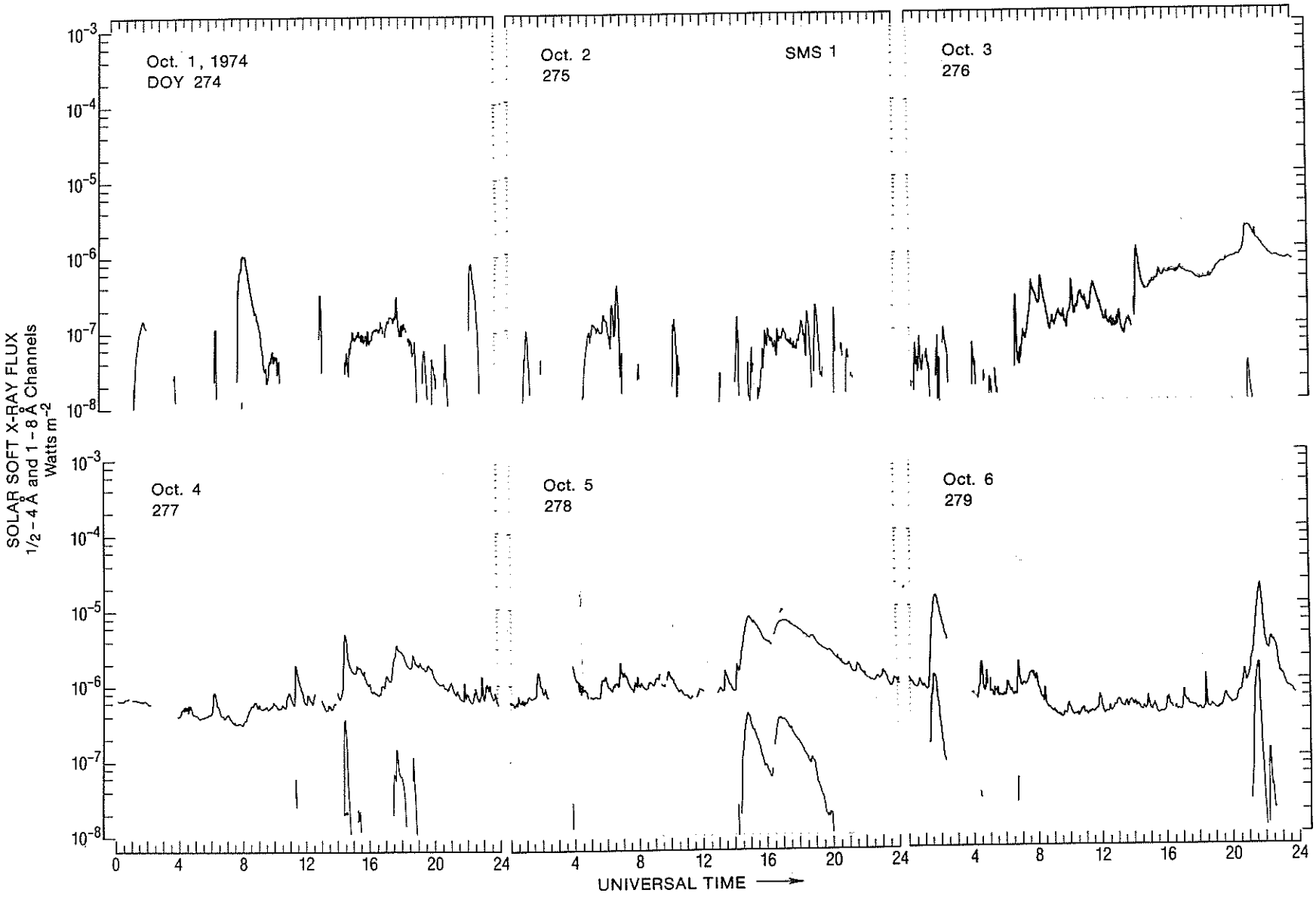


Figure 30. SMS-1 solar X-ray flux of October 1-6, 1974.

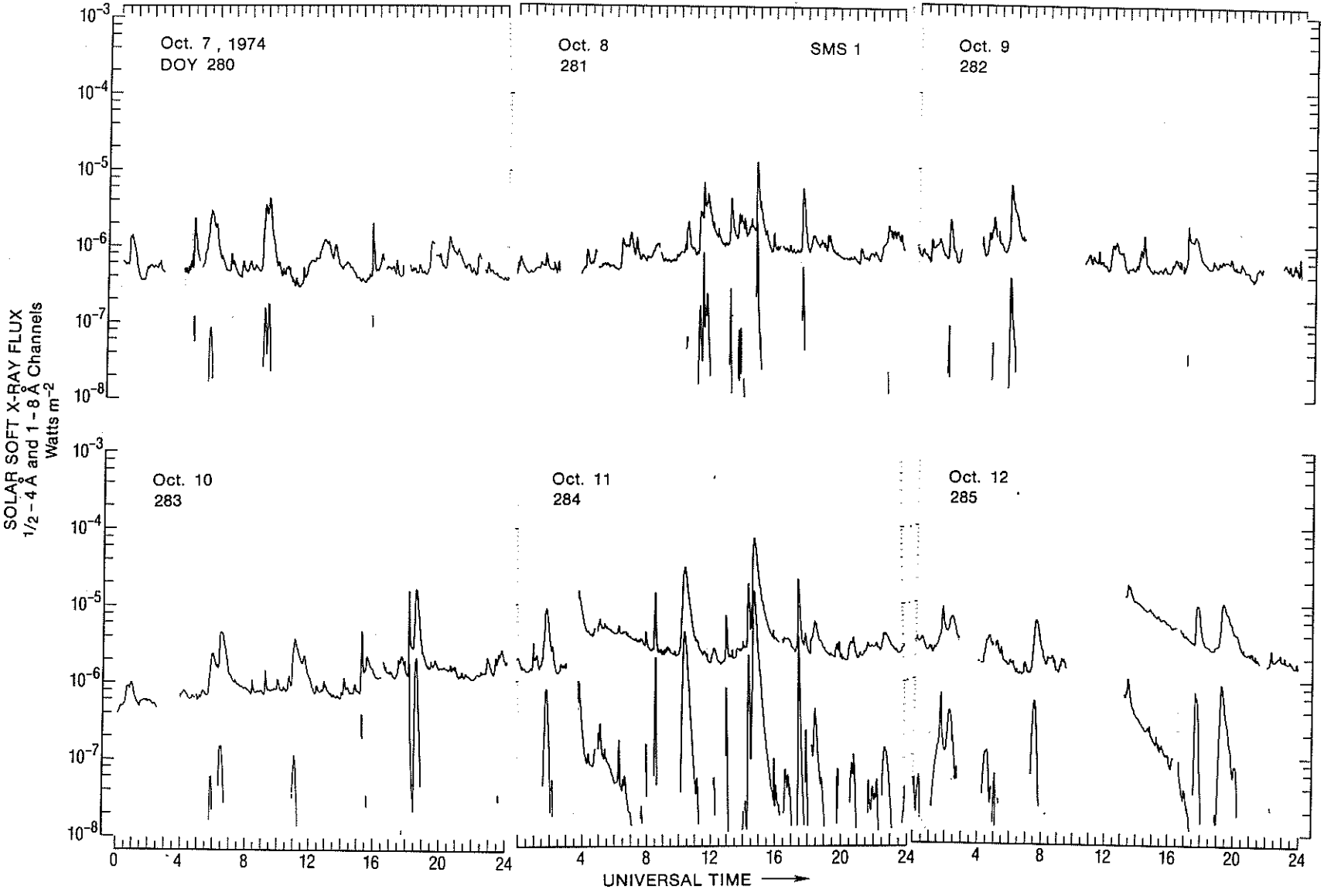


Figure 31. SMS-1 solar X-ray flux of October 7-12, 1974.

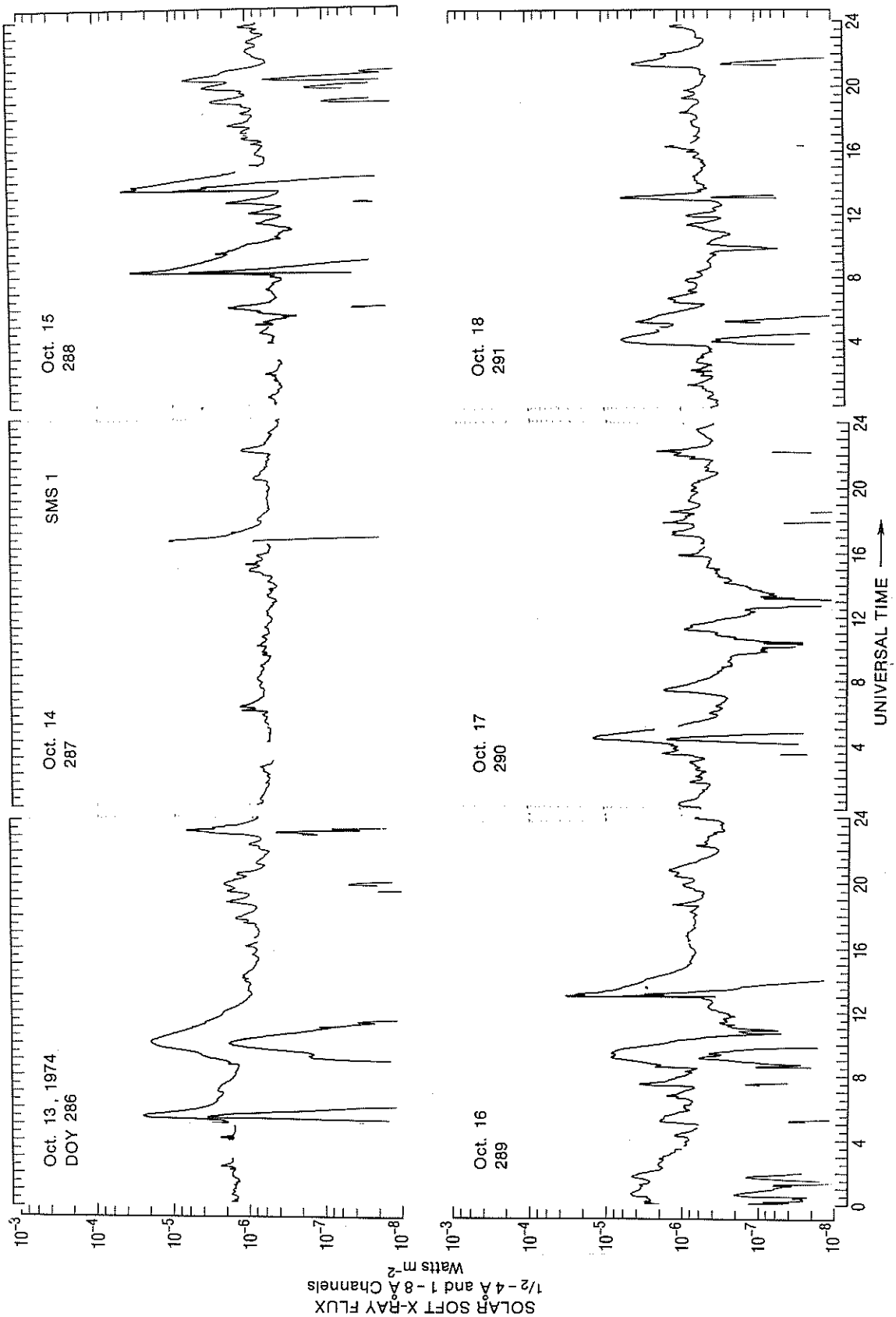


Figure 32. SMS-1 solar X-ray flux of October 13-18, 1974.

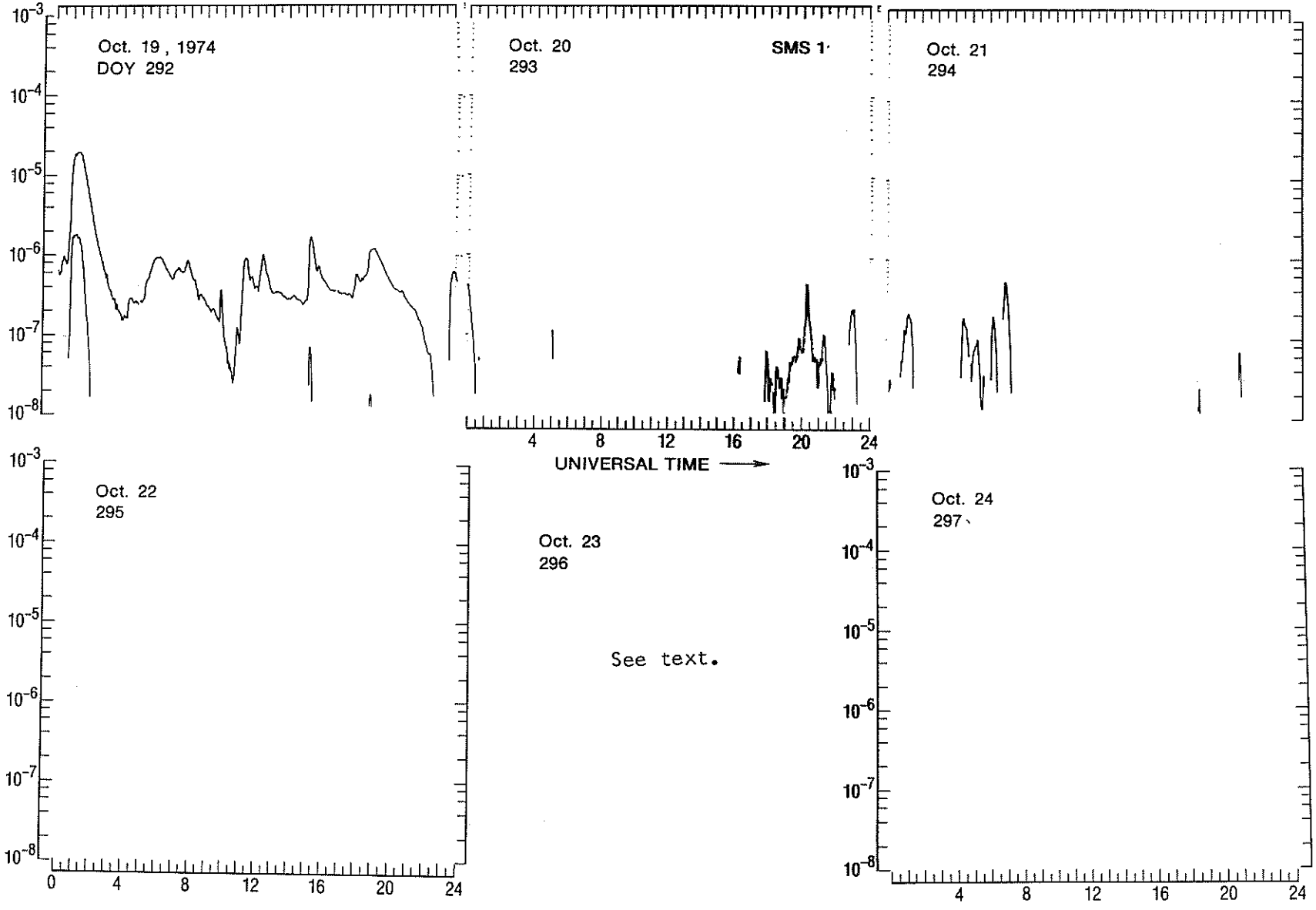


Figure 33. SMS-1 solar X-ray flux of October 19-24, 1974.

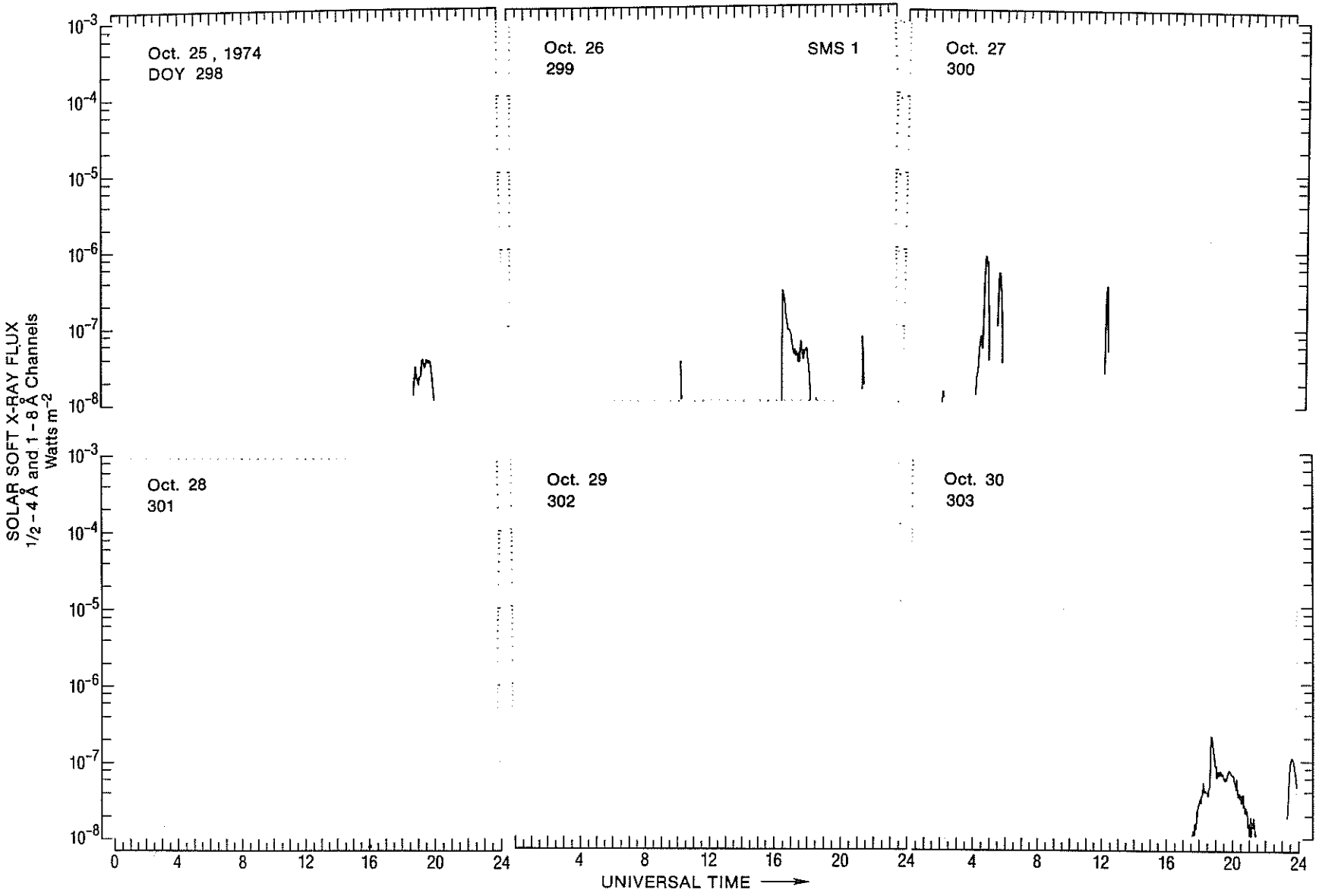


Figure 34. SMS-1 solar X-ray flux of October 25-30, 1974.

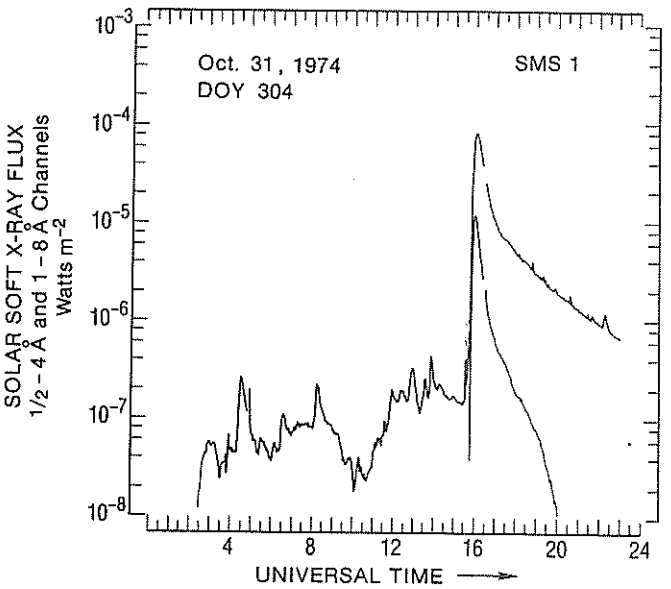


Figure 35. SMS-1 solar X-ray flux for October 31, 1974.

possibly one may have occurred near 0330 UT on October 11, while SMS-1 was in the Earth's shadow.

2.4.2 Missing Data

This section is intended to be used only by persons who need information about the X-ray flux at specific times when the graphs do not clearly illustrate the X-ray flux. No solar X-ray flux measurements were made while the satellite was in the Earth's shadow near 0300 UT for about an hour and a half early in the month, reducing to about an hour at midmonth, but just ten minutes on October 16 near 0330 UT, with no outages thereafter. Calibrations lasting about ten minutes just before 0100 and 1400 UT on October 1-3, before 0100 UT on October 4 and 1630 UT on October 5, and near 0500 and 1630 UT daily for October 6-31, except the afternoon calibrations moved to near 1700 UT on October 19 and 21, 1815 UT on October 22, 1730 UT on October 23, and 1530 UT on October 25. Other losses of data occurred during the following periods: 0210 - 0348 UT (1-8Å channel only), October 1; 1232 - 1257 UT, October 4; 1122 - 1138 and 1205 - 1259 UT, October 5; 1734 - 1800, 1927 - 1936, and 2221 - 2236 UT, October 7; 0639 - 1023 and 2132 - 2244 UT, October 9; 0925 - 1303 and 2132 - 2156 UT, October 12; near 1500 UT, October 15; 1420 - 1520 UT, October 22; and after 2300 UT, October 31. Some of the apparent sharp dips in X-ray flux, e.g., near 1100 UT on October 16, 1000 and 1300 UT on October 17, 1000 UT on October 18, and 1100 UT on October 19, do not appear to be natural solar flux variations. The UV-photoelectron problem in the SMS-1 X-ray instrument partially contributed to these "distorted" sharp dips. Energetic particle interference may also have contributed to these events. Other times when the X-ray flux is not shown in the figures are times when the measured 1-8A flux is below 10^{-8} Wm^{-2}, which at

such low measured flux levels is too low for SMS-1 because of the UV-photo-electron effect. Examples occur at scattered times on October 1-3, 19-21, 25-27 and 30-31, and all day October 22-24 and 28-29. Figure 33 shows no graph for October 23, but the data exist and are below 10^{-8} Wm^{-2} except for a microburst at 0816 UT.

2.5 November 1974, SMS-1

2.5.1 Solar Activity Overview

The X-ray flux remained at moderate levels during the first week of November, dropping to low levels during the second week, rising to low-moderate levels during the third week and then dropping to very low flux levels during the last few days at the end of the month. Flaring rose from a flurry of microflares on November 1 and 2 to several C class flares and one fast M1 flare on November 3, to an X1 flare on November 5 and three M-class flares on November 6. See figures 41-46.

2.5.2 Outstanding Event

Figure 41 shows the X1 flare of November 5, 1974. The rise time was so fast that several range-change switching transients occurred and caused a short-term gap in the X-ray flux observations near the peak of the event. There were no more X-class bursts in the SMS observations in the subsequent eight months.

2.5.3 Missing Data

Calibrations in November 1974 interrupted the solar flux measurements for about ten minutes twice daily, usually just before 0500 and near 1630 UT. Other types of data outages have decreased significantly relative to the first months of SMS-1 observations. Outages occurred during 2149 - 2225 UT, November 1; 1446 - 1500 UT, November 12; 0200 - 0357 UT, November 13; 1613 - 1623, 1648 - 1707, and 1721 - 1755 UT, November 14; 1638 - 1650 UT, November 24, and finally 1542 - 1545 UT on November 26. In other words, a little more than one percent of the data was missing due to calibrations and less

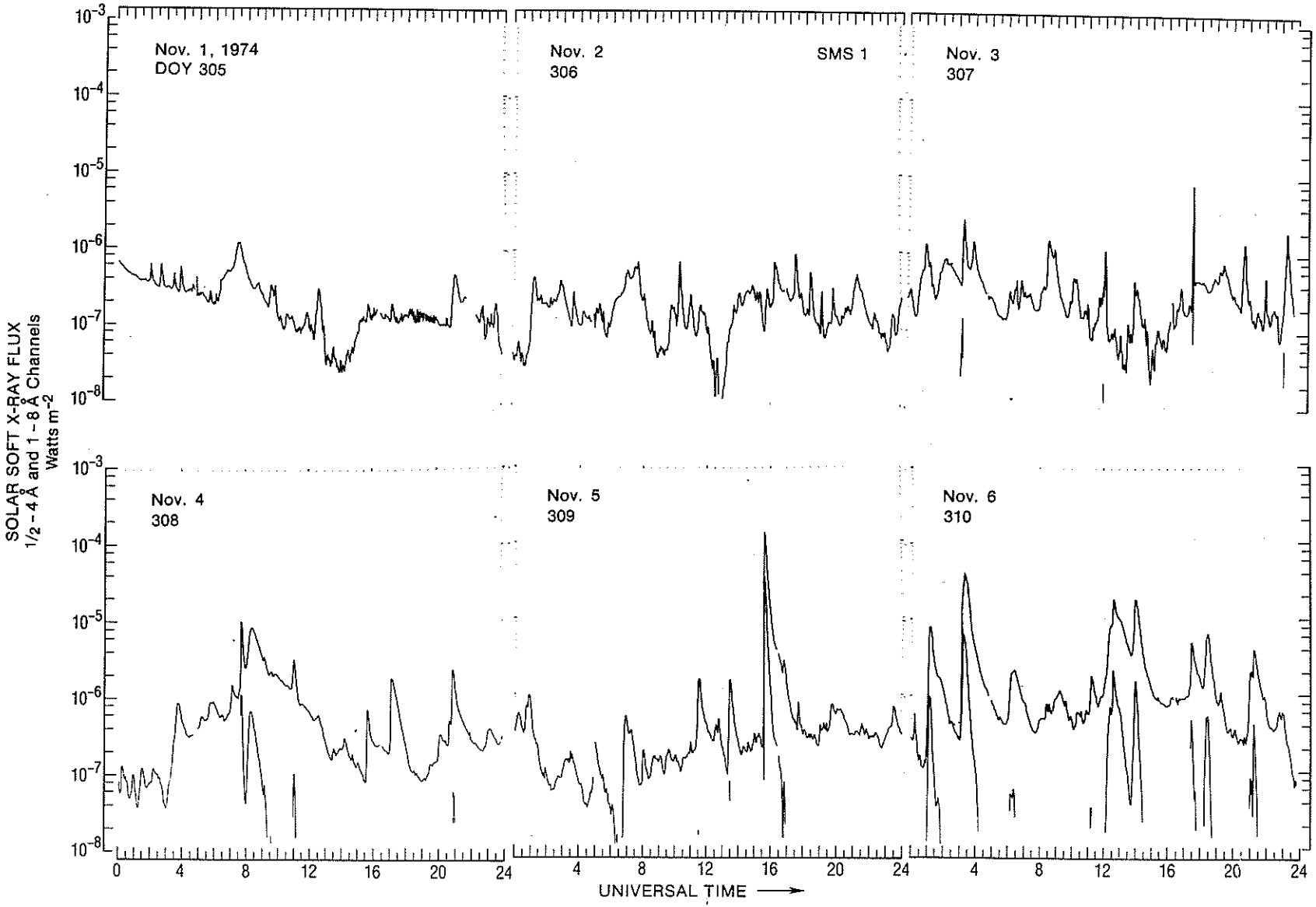


Figure 36. SMS-1 solar X-ray flux of November 1-6, 1974.

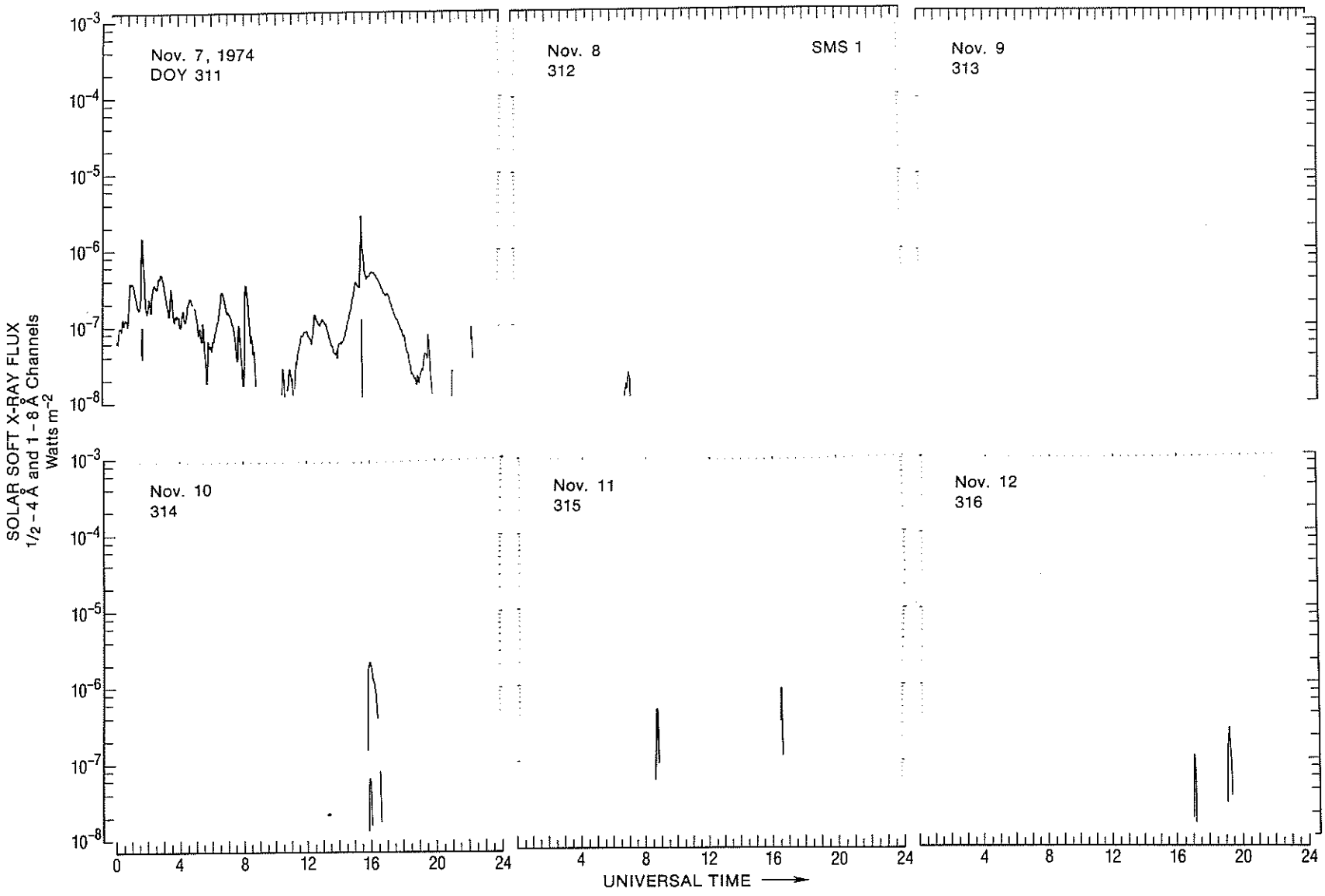


Figure 37. SMS-1 solar X-ray flux of November 7-12, 1974.

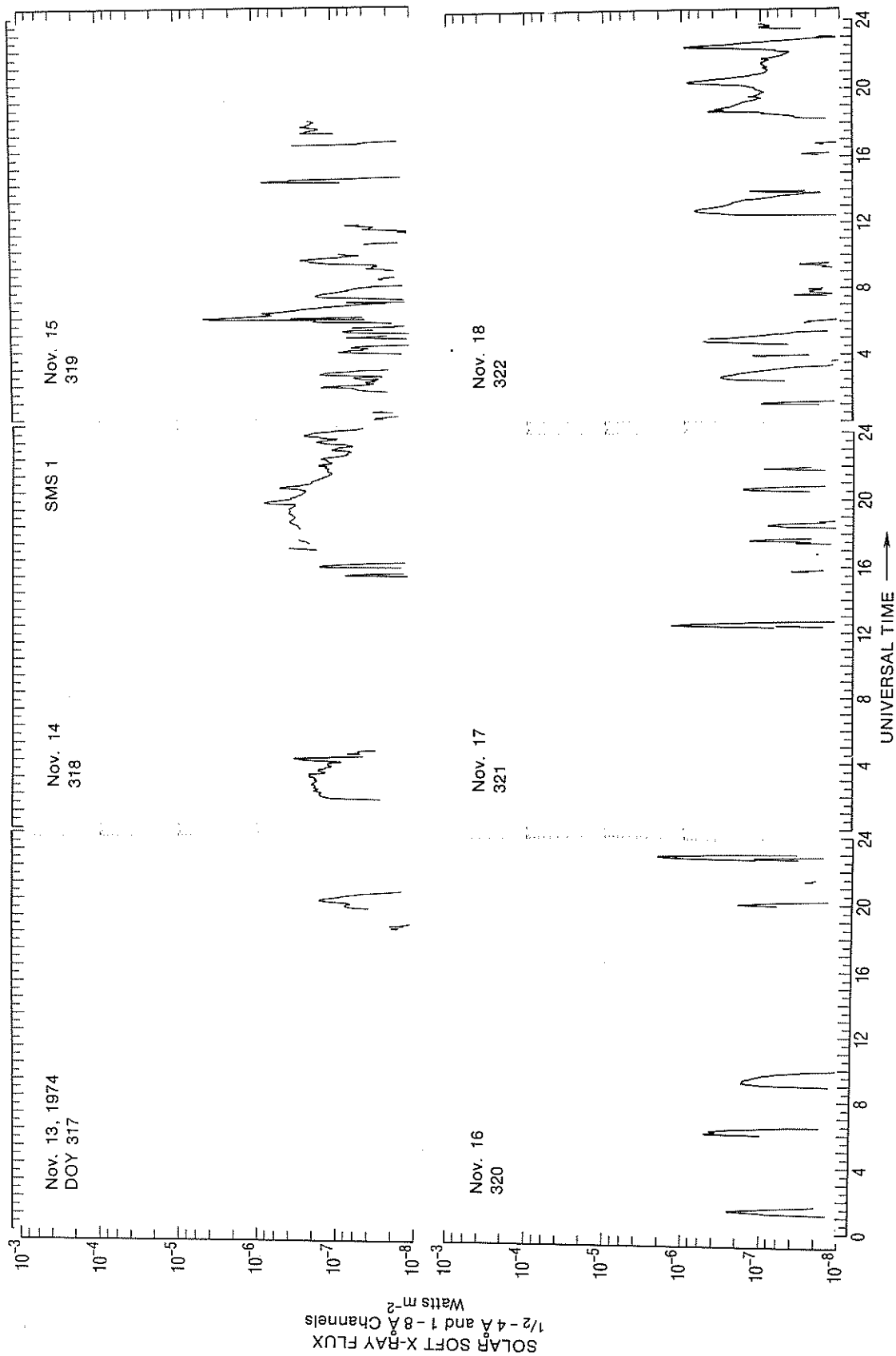


Figure 38. SMS-1 solar X-ray flux of November 13-18, 1974.

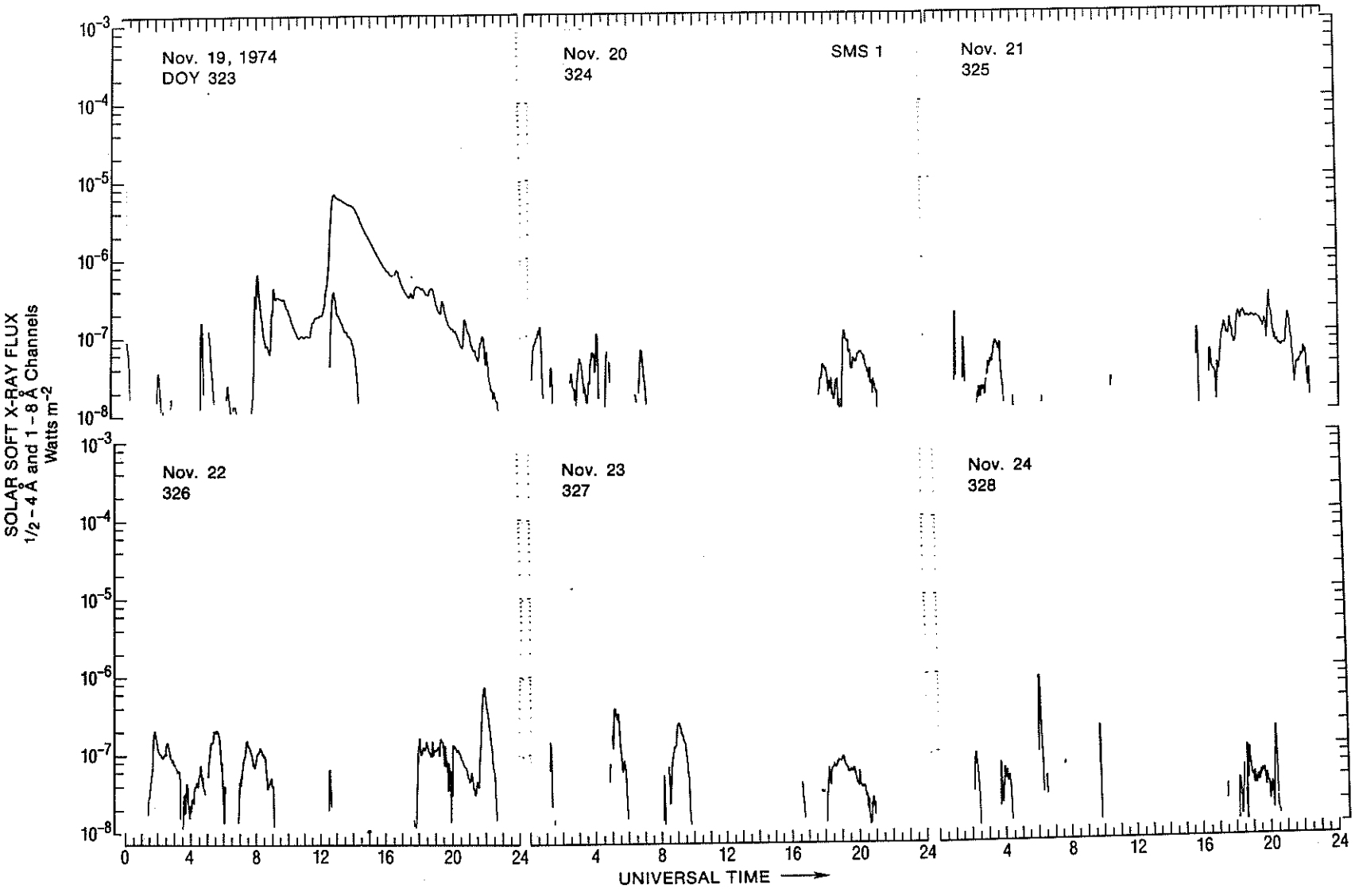


Figure 39. SMS-1 solar X-ray flux of November 19-24, 1974.

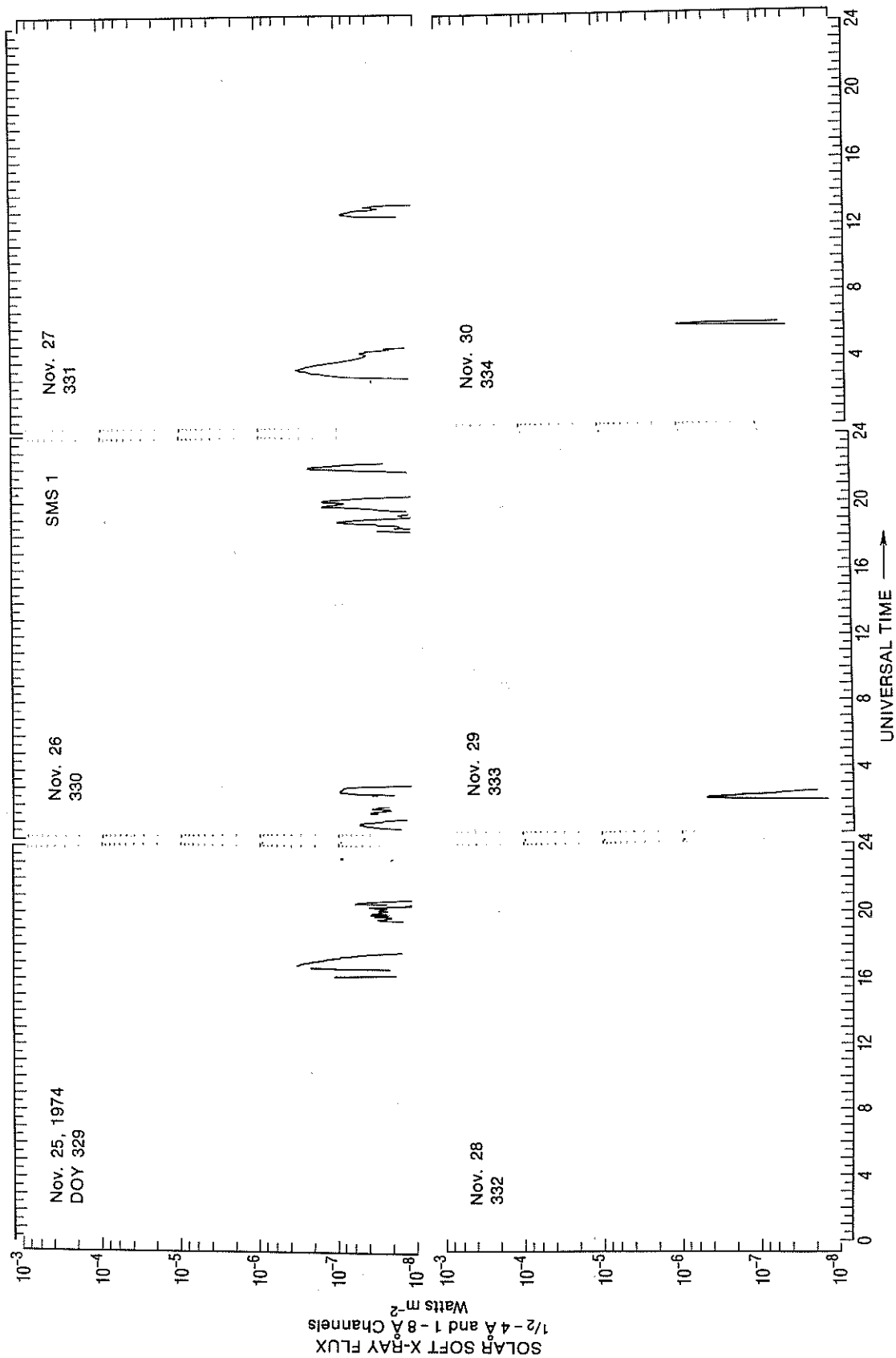


Figure 40. SMS-1 solar X-ray flux of November 25-30, 1974.

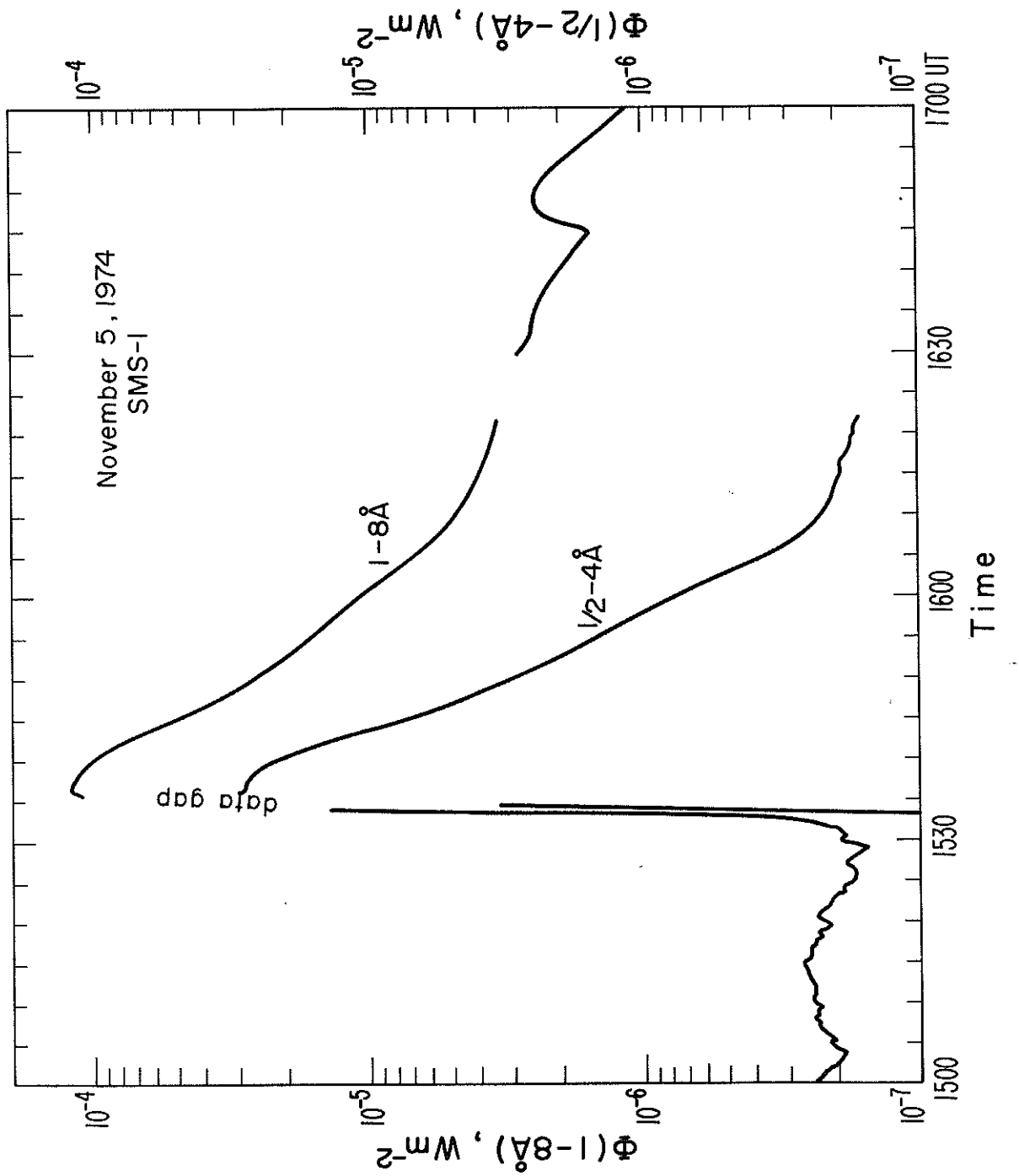


Figure 41. The X1 solar X-ray burst of 1536 UT, November 5, 1974. Calibrations occurred for about eight minutes near 1625 UT.

than one percent due to other outages, or two percent overall. Usually when the data trace does not show in figures 36-40, the X-ray flux as measured by SMS-1 was below 10^{-8} Wm^{-2}.

2.6 December 1974, SMS-1

2.6.1 Solar Activity Overview

The low fluxes present at the end of November continued into December. Data are now missing for December 1-5. The SMS-1 fluxes were below 10^{-8} Wm^{-2} from December 6-10. Minor flaring occurred through mid December, but no large or moderate bursts occurred. At the end of December, the SMS-1 flux was again below 10^{-8} Wm^{-2}.

2.6.2 Missing Data

Calibrations caused the loss of about ten minutes of data twice daily, usually just before 0500 and 1630 UT, except for a shift to 0530 UT for December 15 and 17, a shift to 1700 UT on December 23 and 24, and a shift to near 2120 UT on December 30. Archived data are now missing for December 1-5. Other outages occurred during 2207 UT December 7 to 0409 UT December 10; 1724 - 2325 UT, December 13; 2034 UT December 16 to 0237 UT December 17; 1712 - 2314 UT, December 20; 1547 - 1559 UT and scattered small outages during the 2000 and 2100 UT hours of December 23 and 1600 UT hour on December 24. Outages also occurred 2200 - 2259 UT, December 24; 1552 - 2153 UT, December 27; 1549 - 1730 UT, December 30; and 0015 - 0617 UT, December 31.

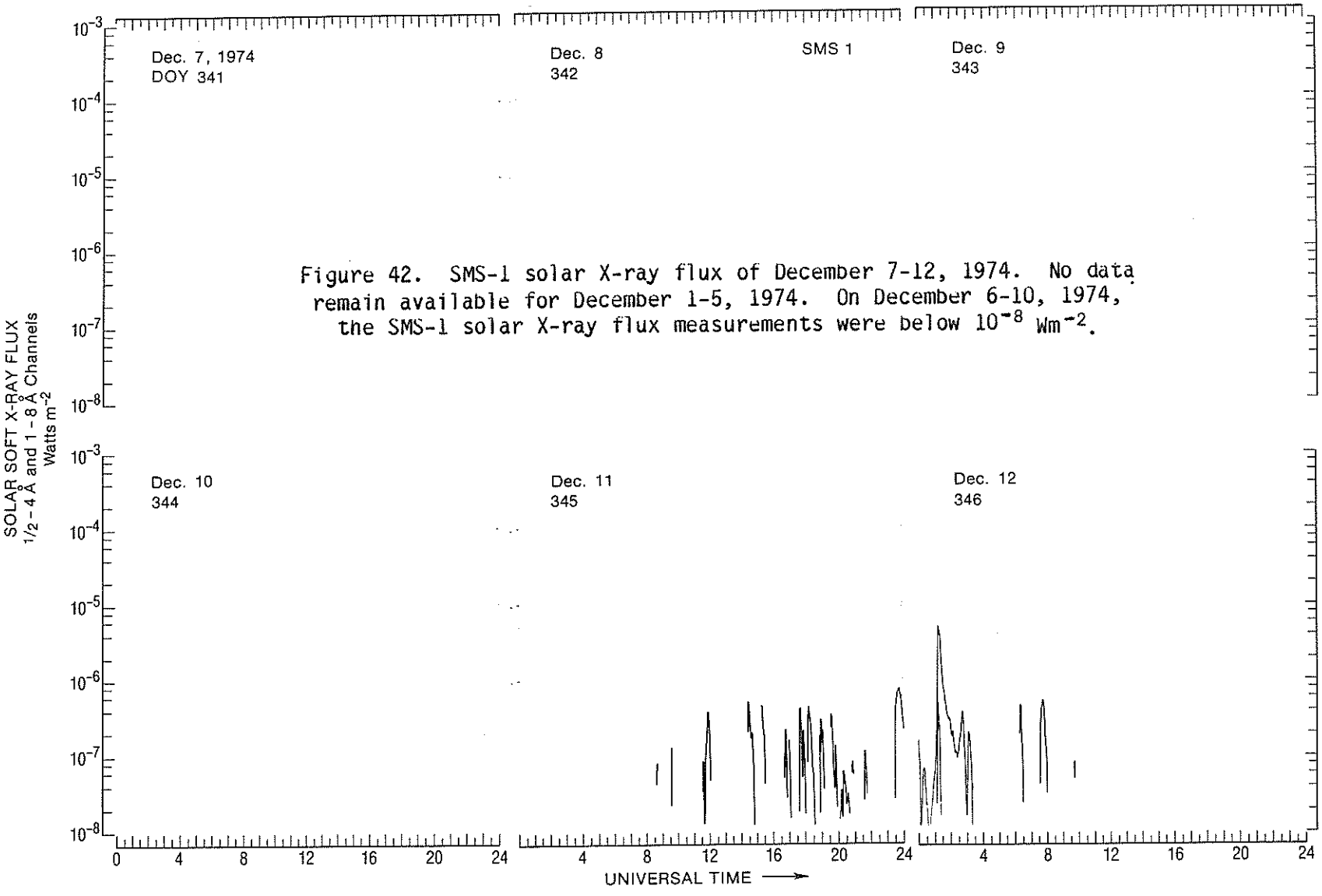


Figure 42. SMS-1 solar X-ray flux of December 7-12, 1974. No data remain available for December 1-5, 1974. On December 6-10, 1974, the SMS-1 solar X-ray flux measurements were below 10^{-8} Wm^{-2}.

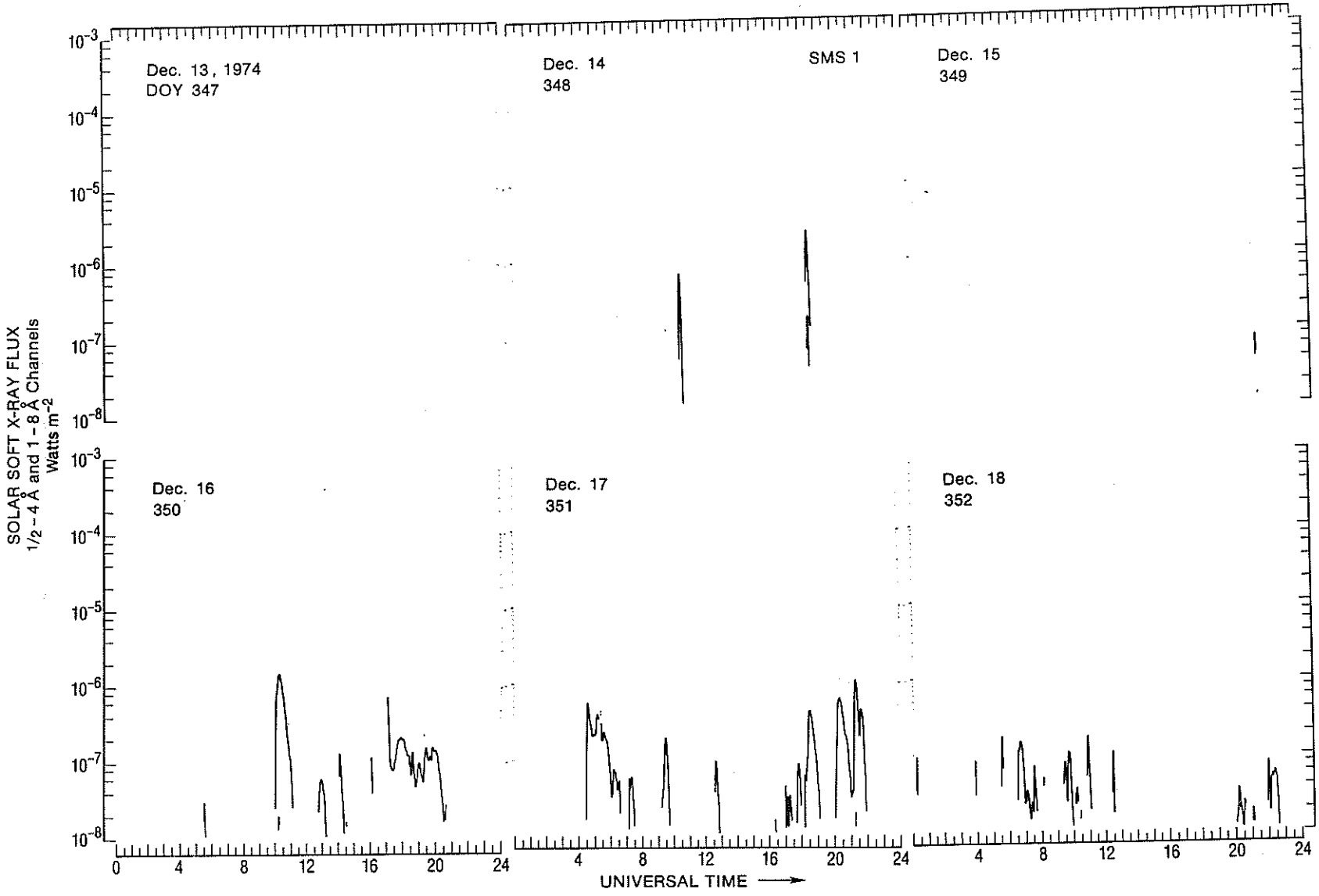


Figure 43. SMS-1 solar X-ray flux of December 13-18, 1974.

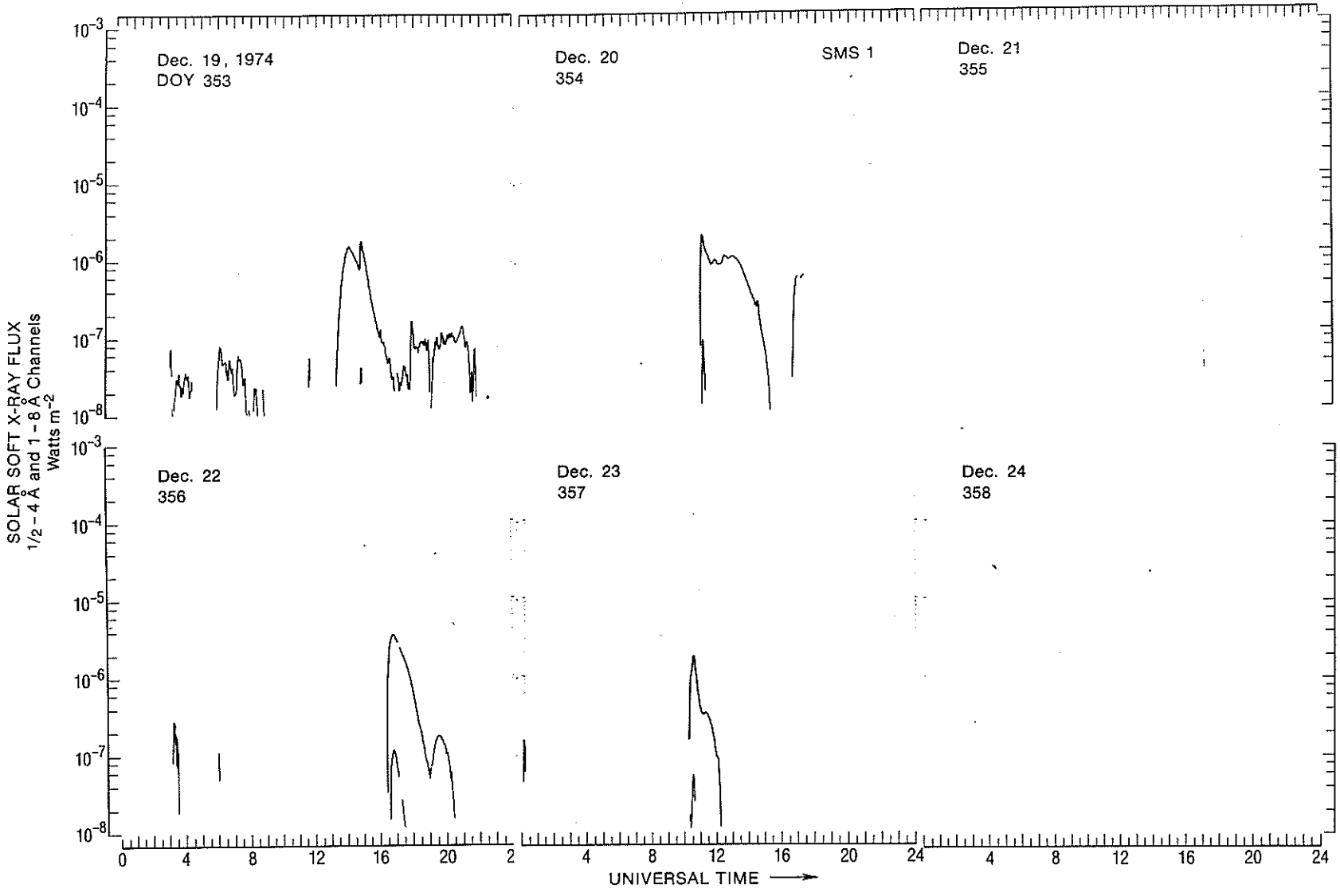


Figure 44. SMS-1 solar X-ray flux of December 19-24, 1974.

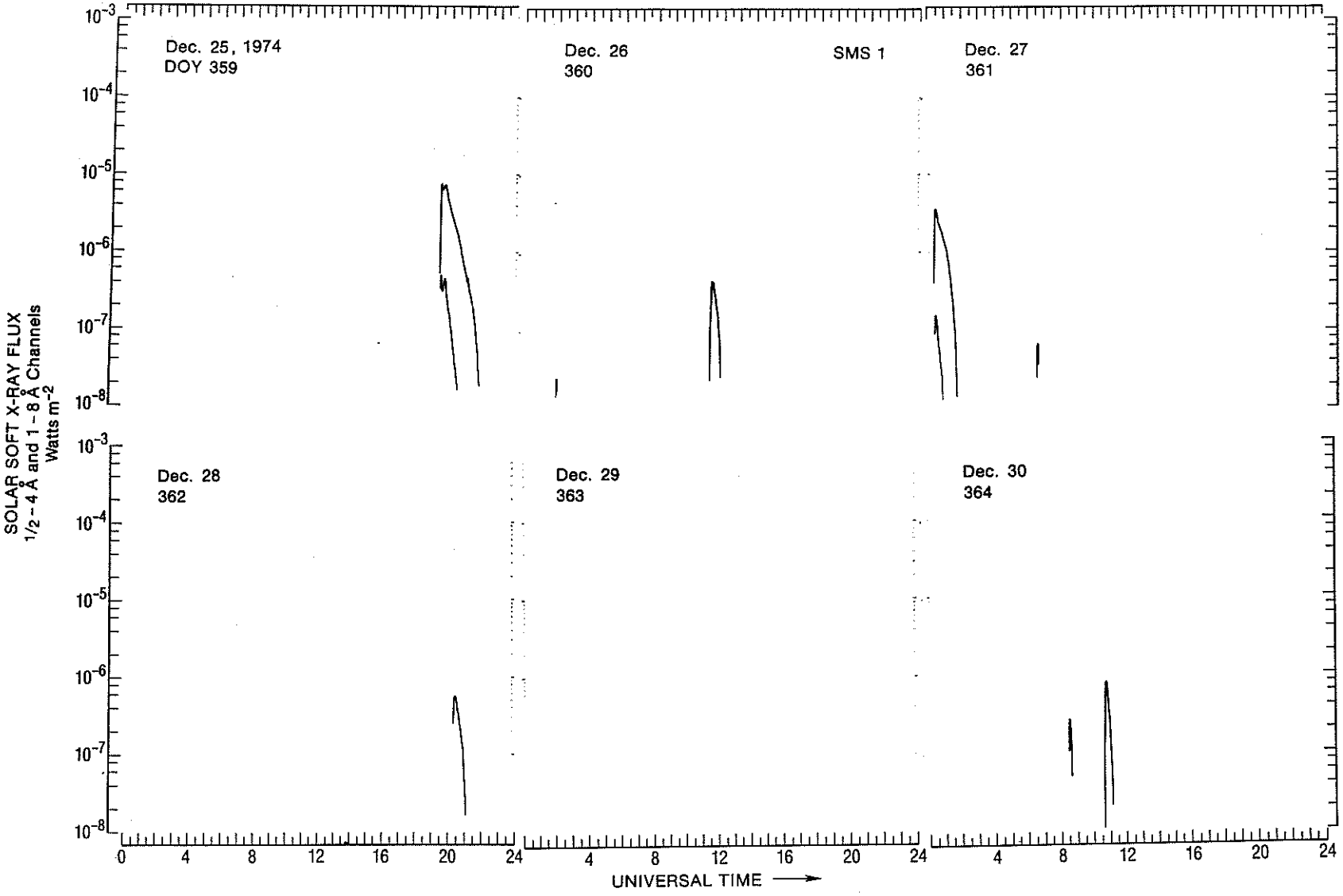


Figure 45. SMS-1 solar X-ray flux of December 25-30, 1974.

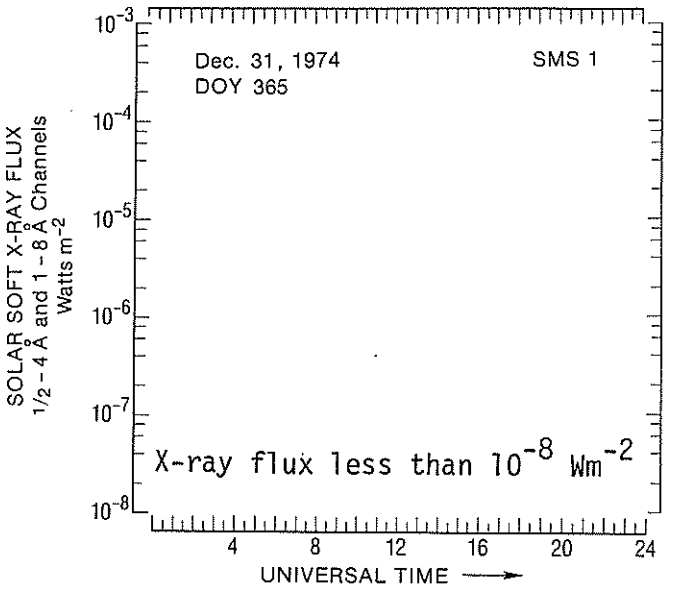


Figure 46. SMS-1 solar X-ray flux for December 31, 1974.

2.7 January 1975, SMS-1

2.7.1 Solar Activity Overview

The solar X-ray flux remained at very low flux levels throughout January, below the graphs, except for a few small bursts in the period January 2-19, 1975. No figures are shown for the period January 19-31, 1975, because the figures were completely blank since the X-ray flux was very low. See figures 47-49.

2.7.2 Missing Data

No archive data are available for January 1. Major data outages occurred during the following periods: 1325 - 1511 UT, January 2; and 0131 - 0257 and 0447 - 0557 UT, January 3. Minor or small scattered outages occurred during the following hours: 15 - 24, January 2; 01 and 04, January 3; 02 and 04, January 25, 21, January 29; and 19, January 30.

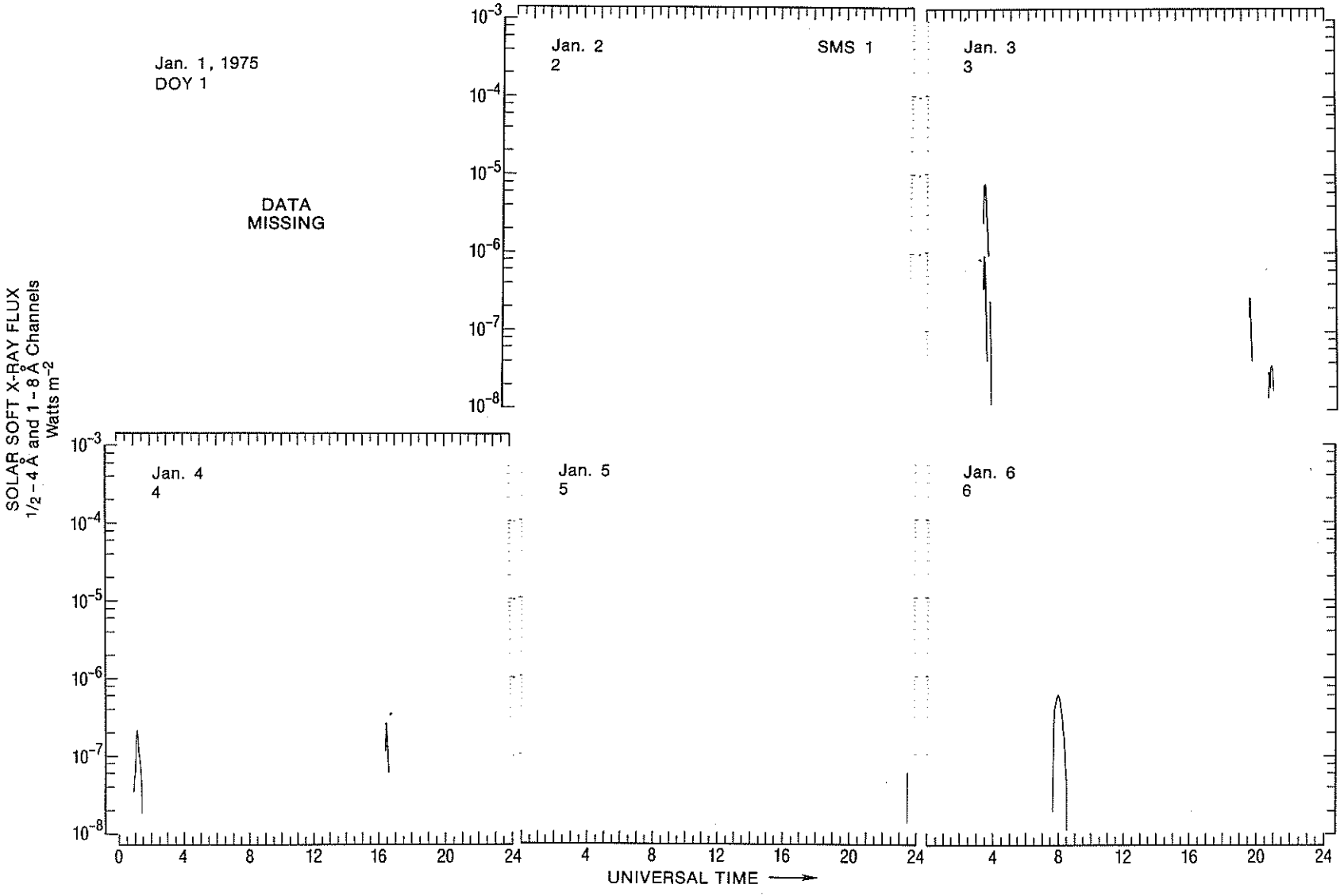


Figure 47. SMS-1 solar X-ray flux for January 1-6, 1975.

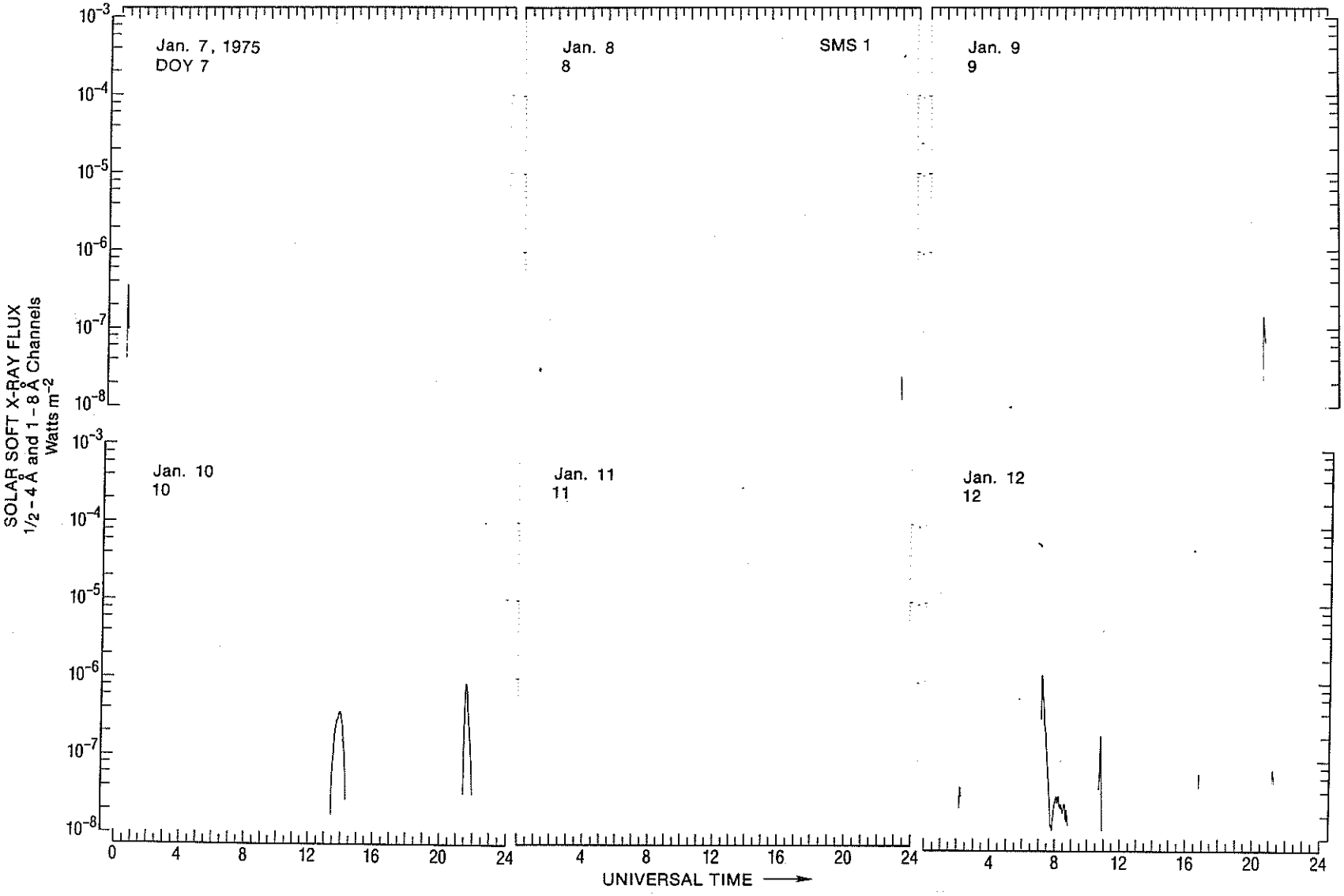


Figure 48. SMS-1 solar X-ray flux for January 7-12, 1975.

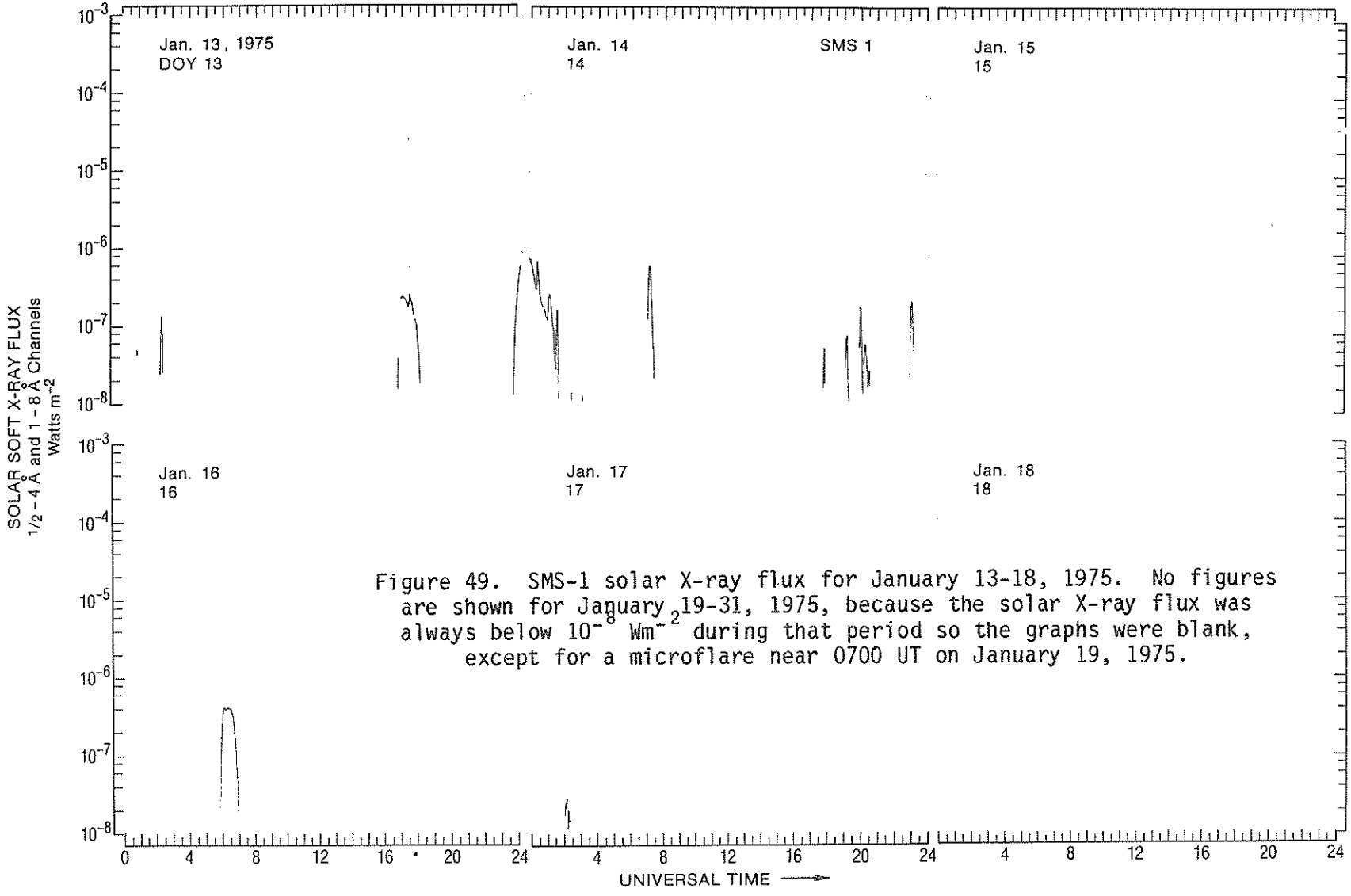


Figure 49. SMS-1 solar X-ray flux for January 13-18, 1975. No figures are shown for January 19-31, 1975, because the solar X-ray flux was always below 10^{-8} Wm^{-2} during that period so the graphs were blank, except for a microflare near 0700 UT on January 19, 1975.

2.8 February 1975, SMS-1 and SMS-2

2.8.1 Solar Activity Overview

The solar X-ray flux remained at low levels throughout February, 1975, except several C class X-ray flares occurred. SMS-2 measurements started in mid February. Because of a problem with a UV-induced photoelectron current, SMS-1 underestimated the solar X-ray flux at low flux levels. This problem was partially corrected in SMS-2, which causes a second problem to be evident in the measurements. Note in figure 52 that the SMS-2 1-8Å flux tends to be about 5 - 10 x 10^{-8} Wm^{-2} near 0700 and 2300 UT daily. This tendency toward diurnal recurrence is probably caused by energetic magnetospheric particle interference in the X-ray detector. Comparisons of concurrent SMS-2 and GOES-1 for later periods indicate that for apparent 1-8A flux levels below 10^{-7} Wm^{-2}, some of the temporal variations, particularly the diurnally recurrent variations, are not real variations in solar X-ray radiation because these are not identical in the data from different satellites. Bursts that look like solar flares that rise to flux levels above 10^{-7} Wm^{-2} are usually real solar temporal variations.

2.8.2 Missing Data

Major outages occurred during the following periods: 2048 UT February 3 to 0849 UT February 4; 0000 - 0518, 0634 - 0831 and 1027 - 1112 UT, February 7; 1721 - 2123 UT, February 8; 2040 - 2110 UT, February 14; 0108 - 0205 and 2027 - 2104 UT, February 15; 0031 - 0315 UT, February 18; 0035 - 0243 UT, February 19; 0849 UT February 22 to 0031 UT February 23; 2246 - 2326 UT, February 24; and 1025 - 1333 UT, February 28.

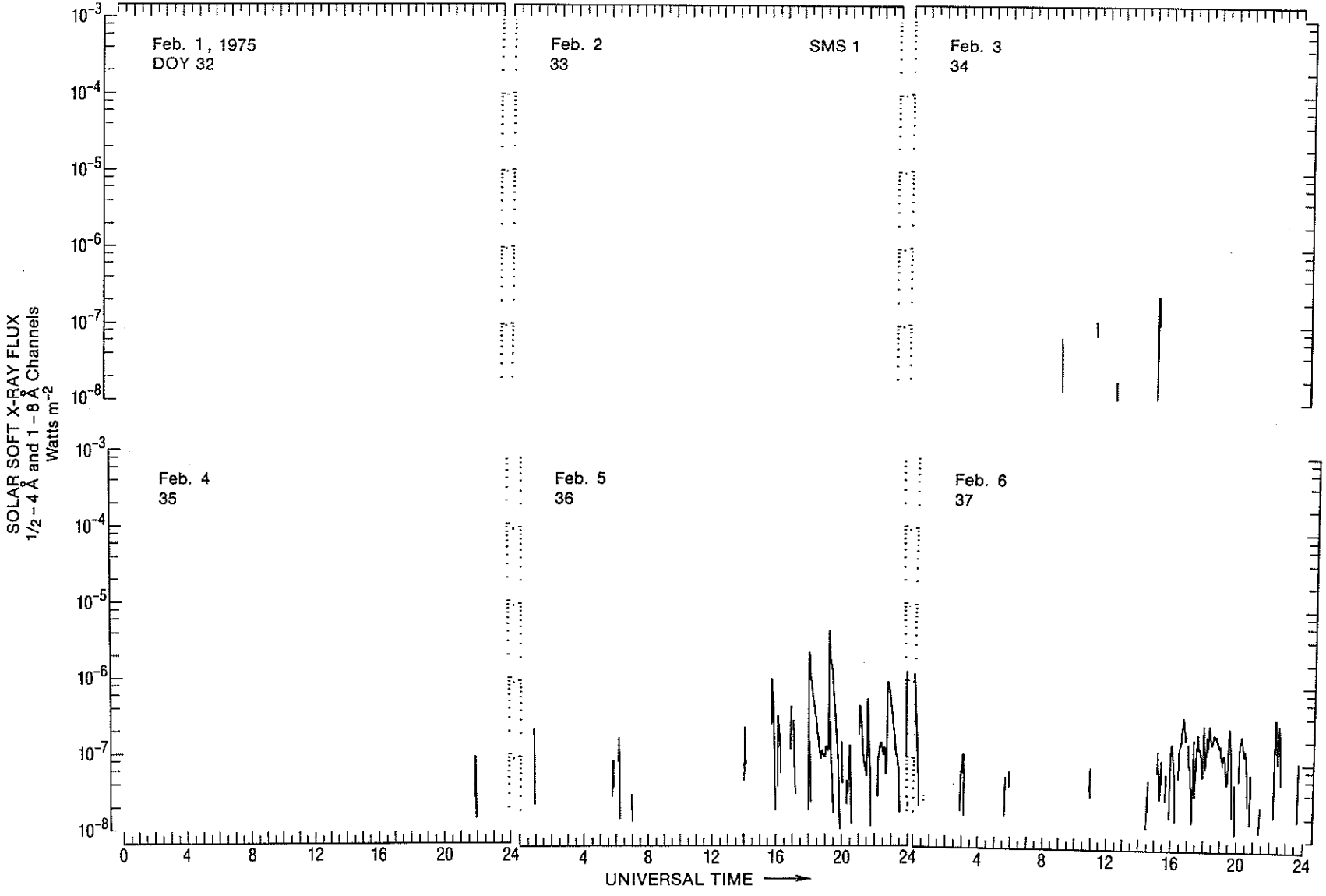


Figure 50. SMS-1 solar X-ray flux for February 1-6, 1975.

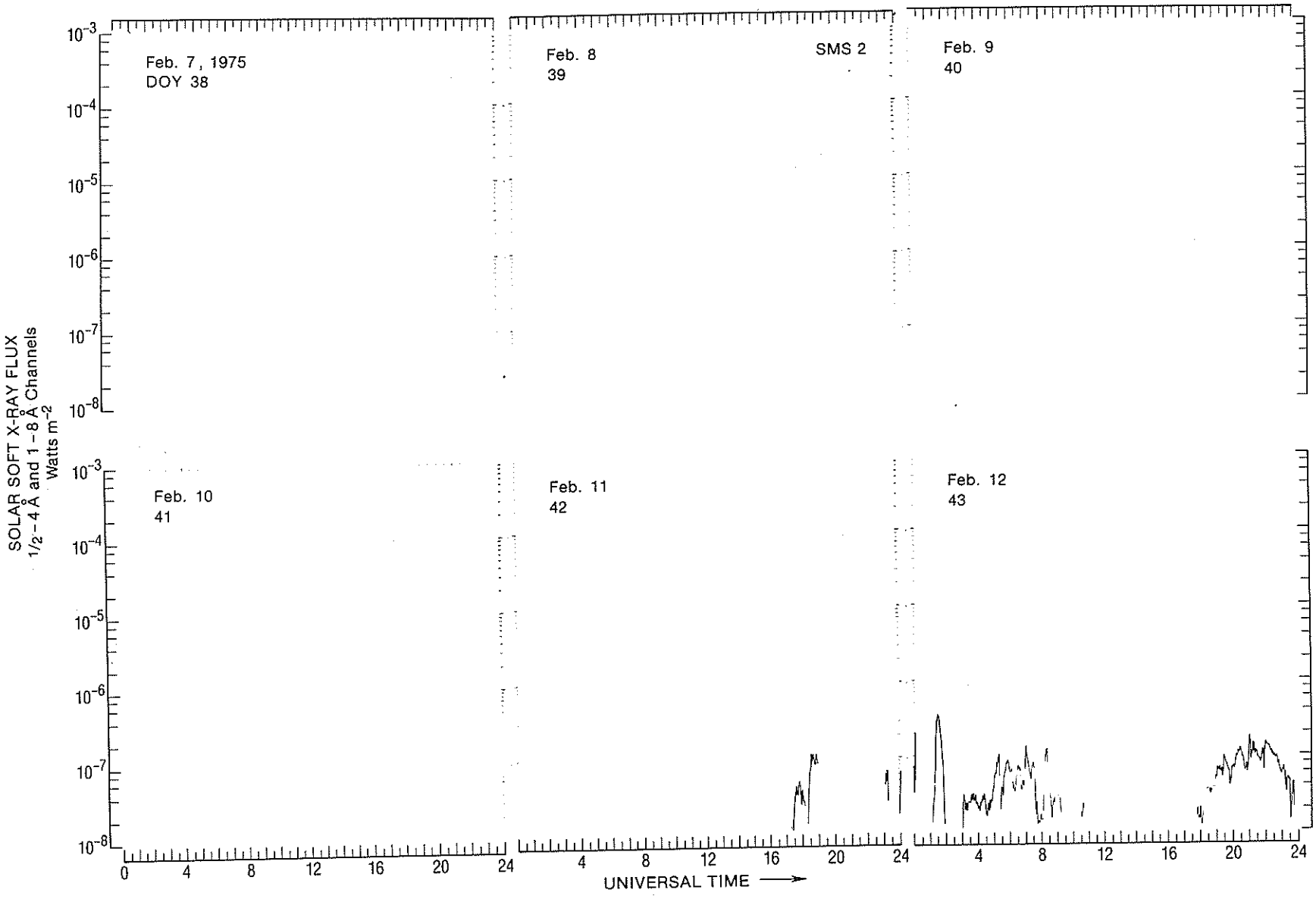


Figure 51. SMS-2 solar X-ray flux for February 7-12, 1975.

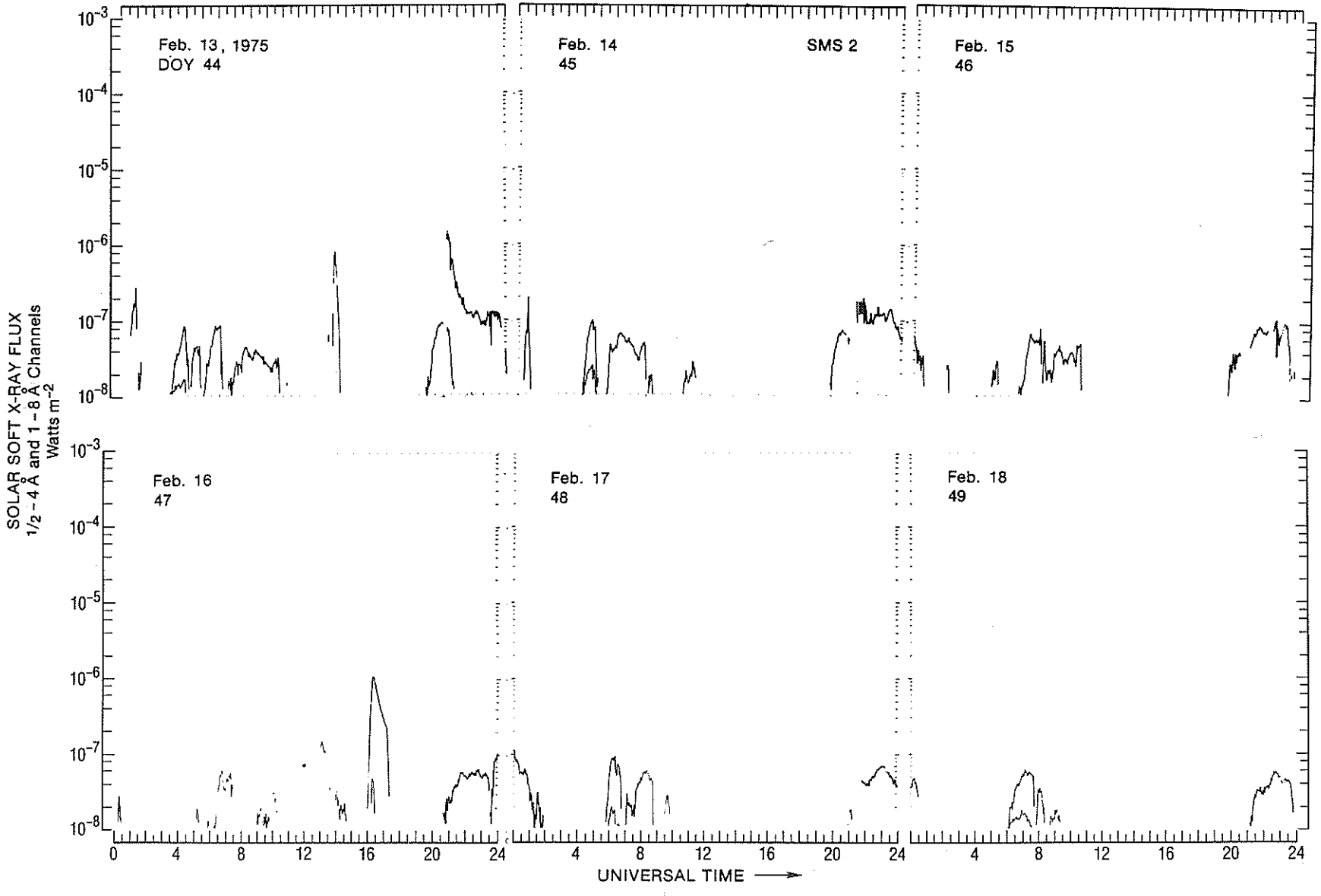


Figure 52. SMS-2 solar X-ray flux for February 13-18, 1975.

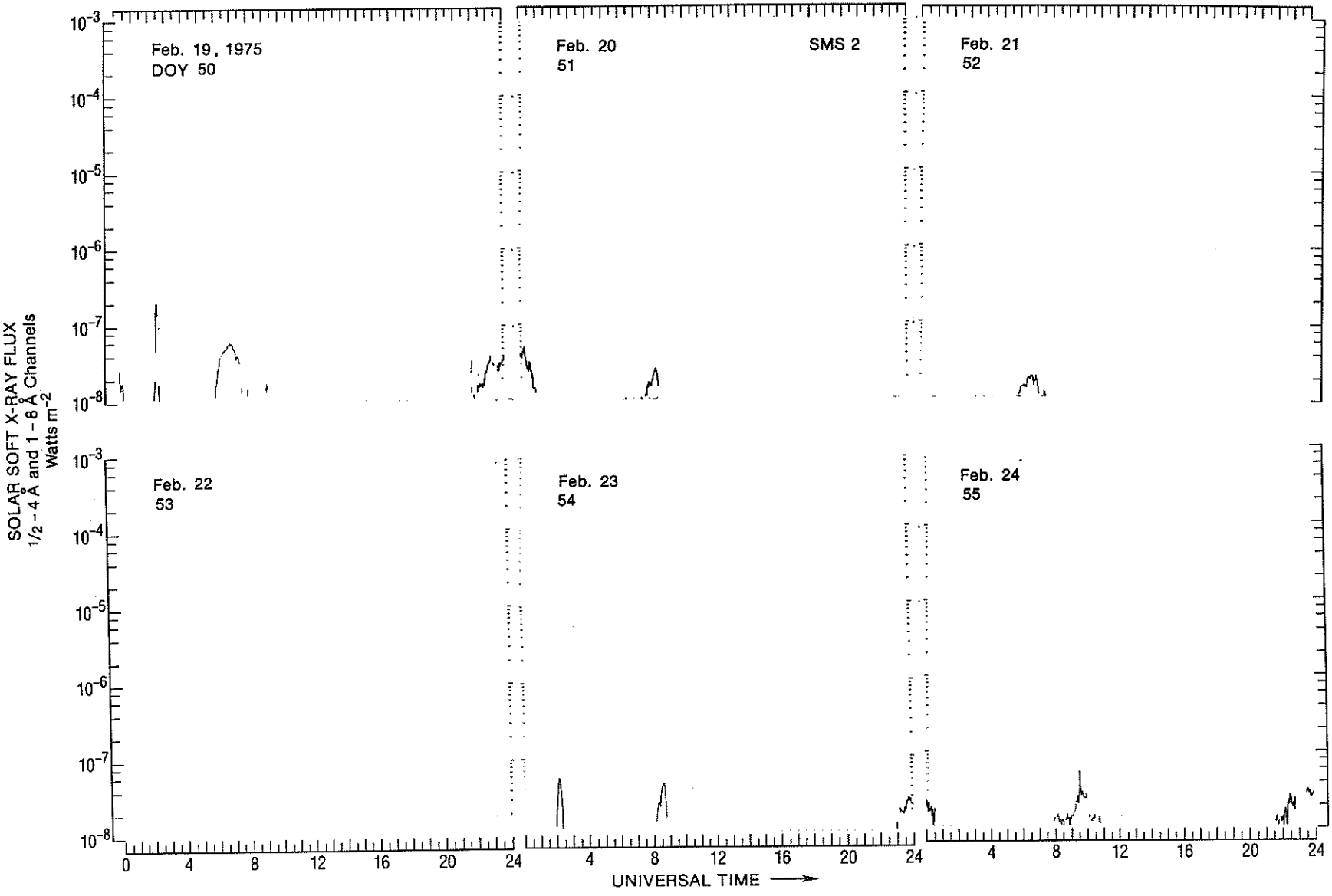


Figure 53. SMS-2 solar X-ray flux for February 19-24, 1975.

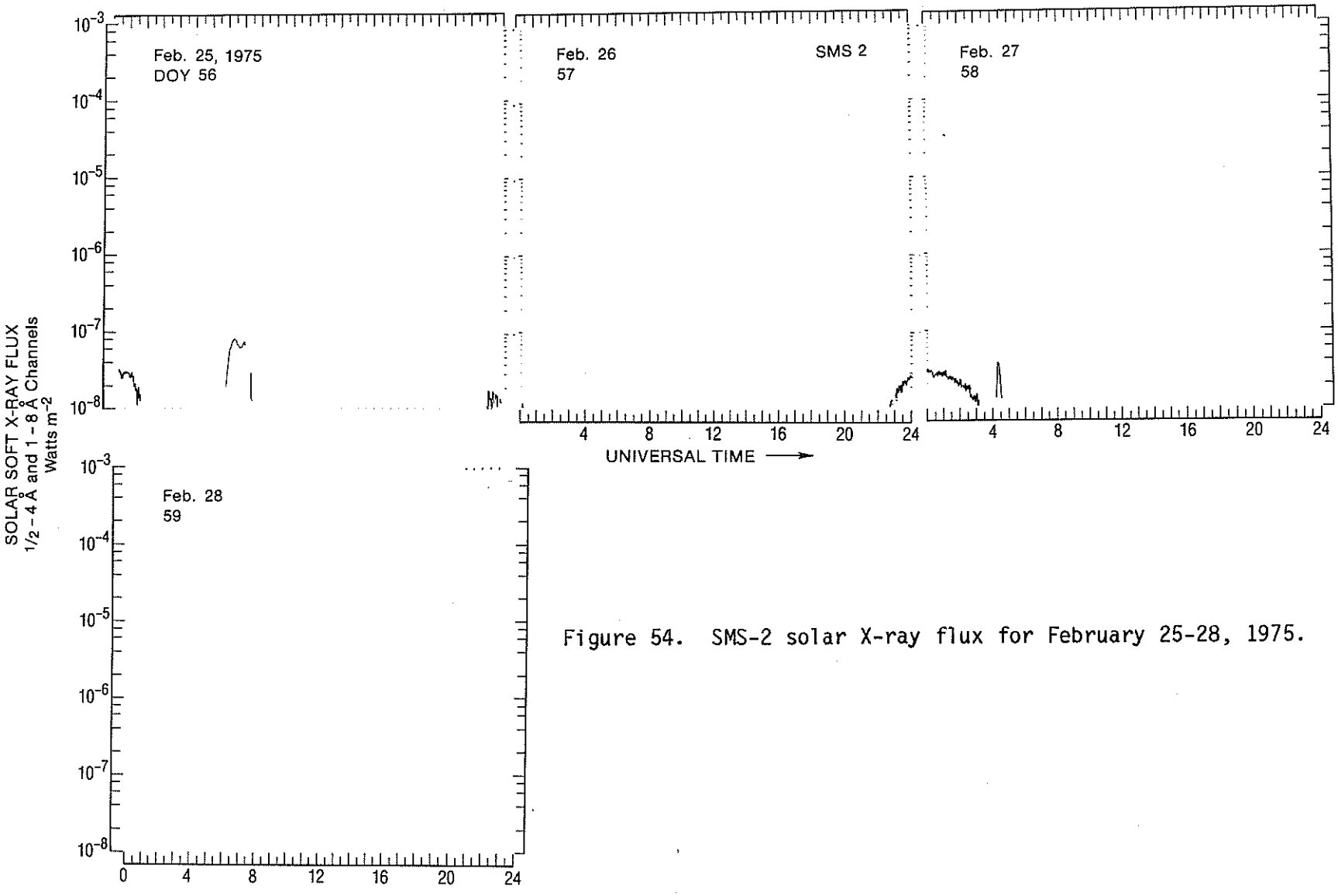


Figure 54. SMS-2 solar X-ray flux for February 25-28, 1975.

2.9 March 1975, SMS-2

2.9.1 Solar Activity Overview

March was another period of low solar X-ray activity, but slightly higher than the previous month, and also a month of large data outages. Several C class flares occurred in the period March 12 - 17, 1975. No graph is shown for March 13, but X-ray data have been found that show a microburst at 1210 UT; i.e. smaller than a C1 class flare.

2.9.2 Missing Data

Starting about March 10, calibrations occurred more regularly twice daily at about 0640 and 1940 UT. Data are missing daily for about an hour near 0800 UT because SMS-2 was in the Earth's shadow. See figure 57. Major data outages occurred during the following periods: 2040 - 2133 UT, March 2; 0735 - 1321 UT and 1741 - 1852 UT, March 4; 0732 - 1324 UT and 1542 - 1606 UT, March 5; 1404 - 1536 UT, March 6; 2355 UT March 7 to 0126 UT March 8; 0501 - 0900 UT, March 8; 0141 - 0211 UT, March 9; 2048 - 2126 UT, March 13; 0038 - 0144 UT, 0159 - 0225 UT, 0423 - 0441 UT, and 0456 - 0517 UT, March 14; 2045 UT March 17 to 1052 UT March 24 (except for short segments of data shown in figure 58), most of 1600 and 2000 hours on March 24; 0300 hour on March 25; 0415 - 0628 UT, March 26; 0415 - 1100 UT and 2226 - 2400 UT on March 27; 0713 - 1318 UT, March 28; and 0607 - 0945 UT, March 30.

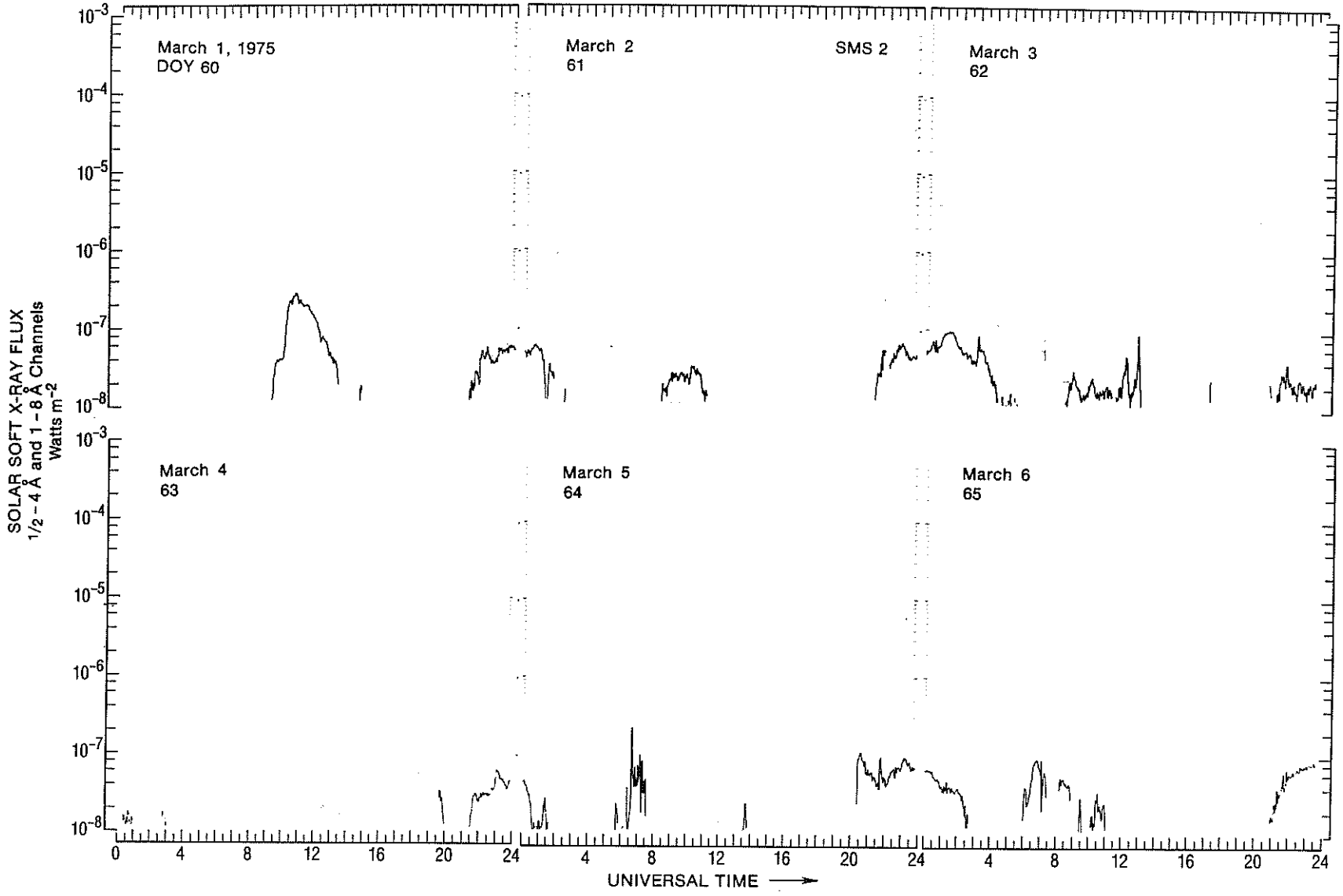


Figure 55. SMS-2 solar X-ray flux for March 1-6, 1975.

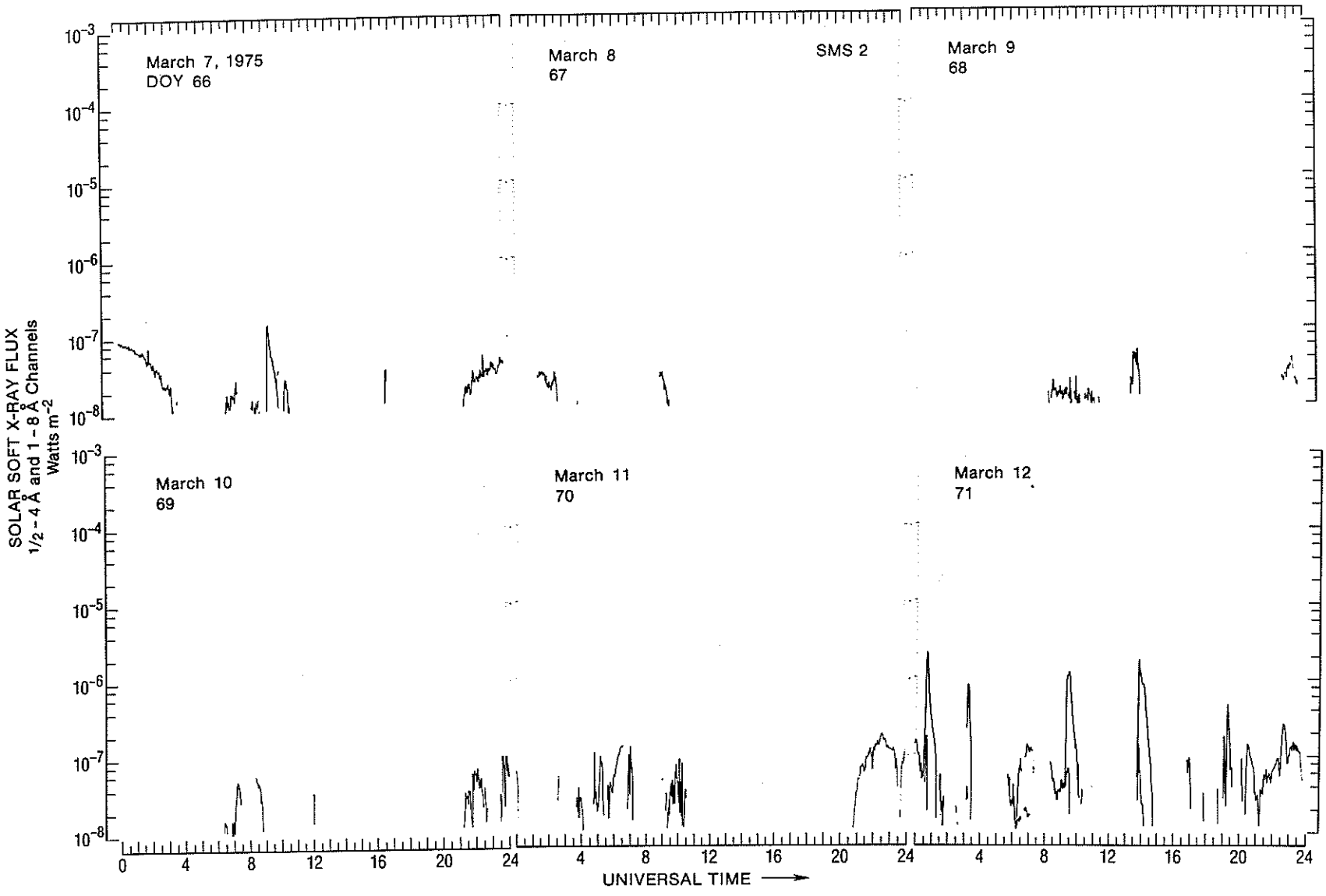


Figure 56. SMS-2 solar X-ray flux for March 7-12, 1975.

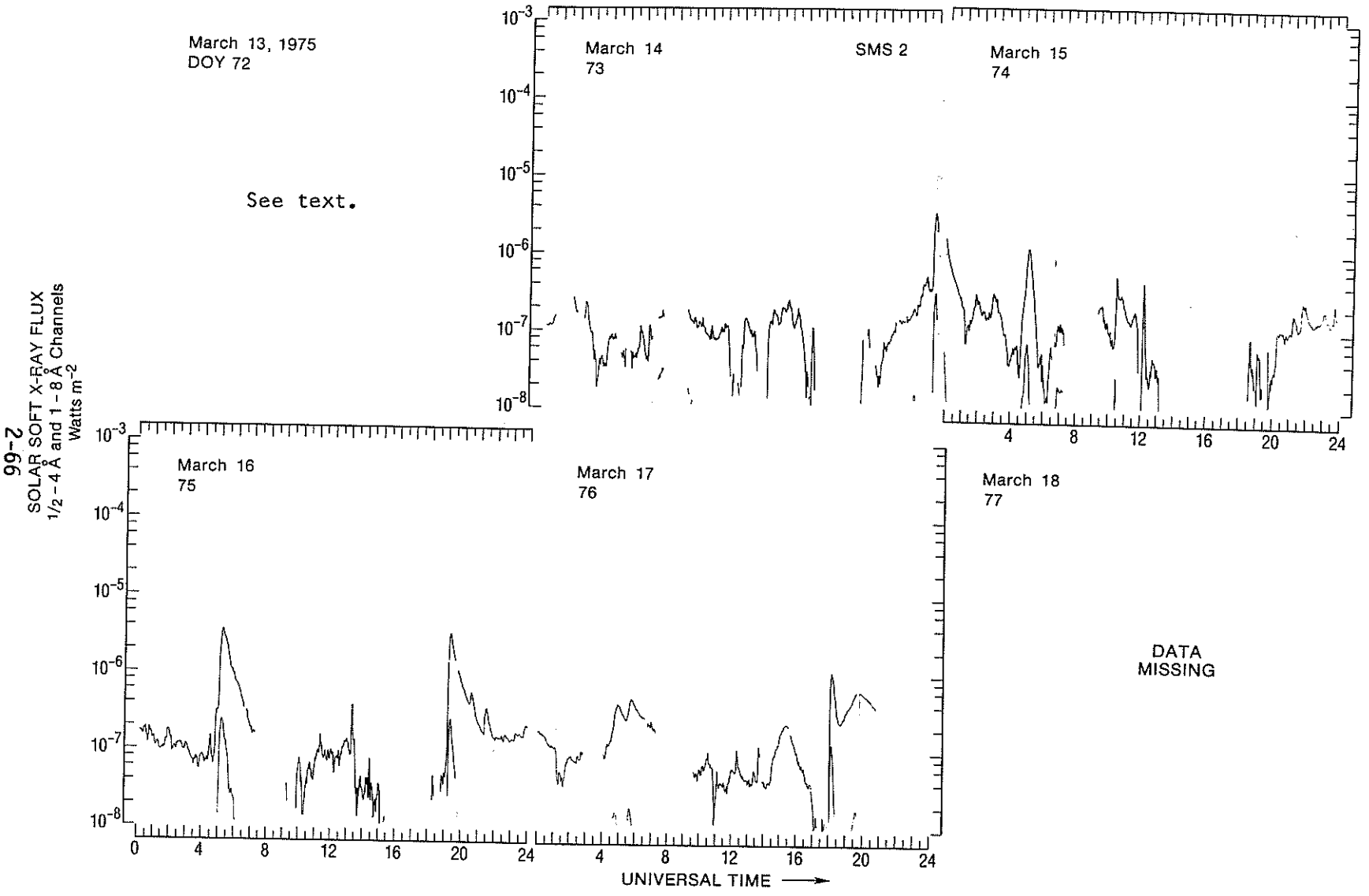


Figure 57. SMS-2 solar X-ray flux for March 13-18, 1975.

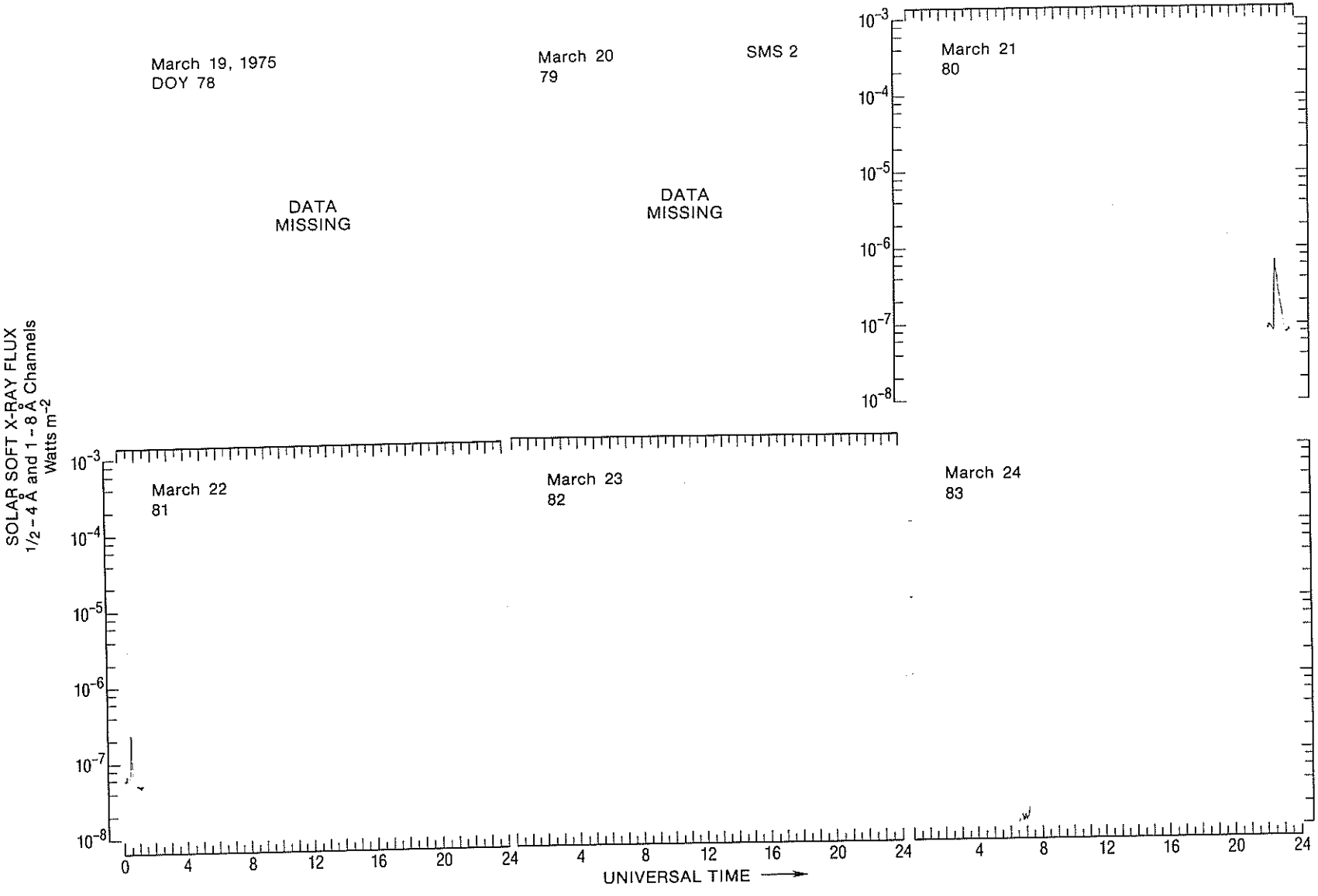


Figure 58. SMS-2 solar X-ray flux for March 19-24, 1975.

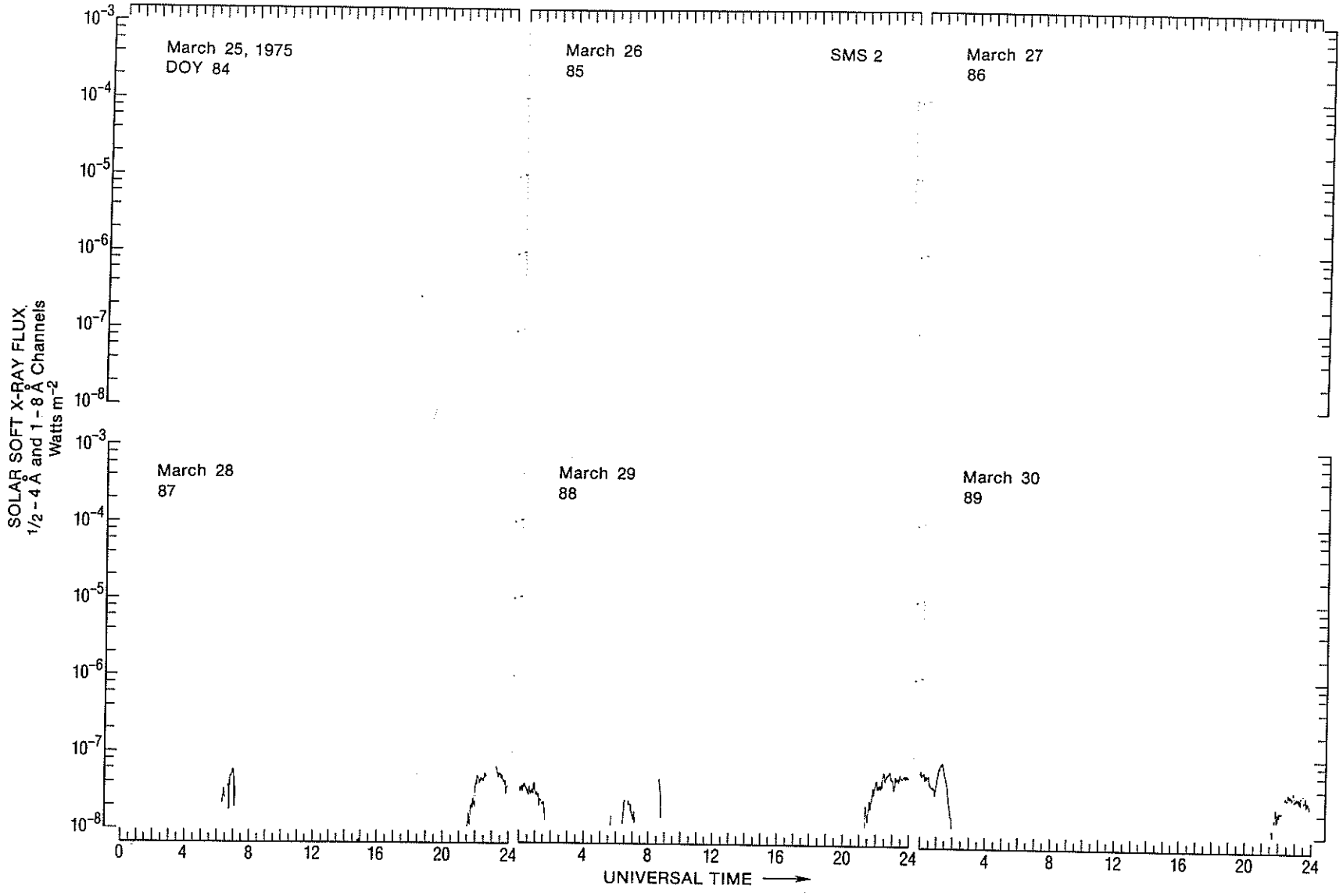


Figure 59. SMS-2 solar X-ray flux for March 25-30, 1975.

2.10 April 1975, SMS-2

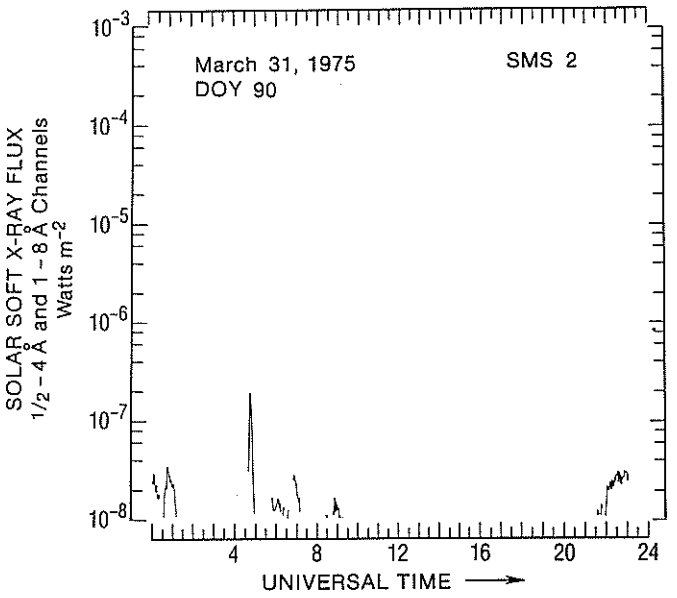


Figure 60. SMS-2 solar X-ray flux for March 31, 1975.

2.10.1 Solar Activity Overview

The solar X-ray flux rose during April from very low flux levels of the first three weeks to low flux levels during the last week. A C2 X-ray burst occurred on April 26, the highpoint of the activity in April. See figures 61-65.

2.10.2 Missing Data

Calibrations, lasting about ten minutes, occurred daily near 0640 and 1940 UT, slipping to about 2010 UT on April 20, 23 and 24. No solar flux measurements were made by SMS-2 for about an hour near 0800 UT daily for the first two weeks of April because the satellite was in the Earth's shadow, which happens for about six weeks near equinox. Major outages occurred during the following periods: 1042 - 1427 and 2145 - 2226 UT, April 3; 1530 - 1739 UT, April 4; 0441 - 0532 UT, April 5; 0232 - 1320 UT, April 7; 0318 - 0438 UT, April 10; 0600 - 1343 UT, April 11; 2236 - 2321 UT, April 14; 0138 - 0426 UT, April 16; 0818 - 1410 UT, April 17; 0338 - 0602 UT, April 18; 0335 - 1407 UT, April 21; 0246 - 0447 UT, April 28; and 2300 - 2400 UT, April 30, 1975.

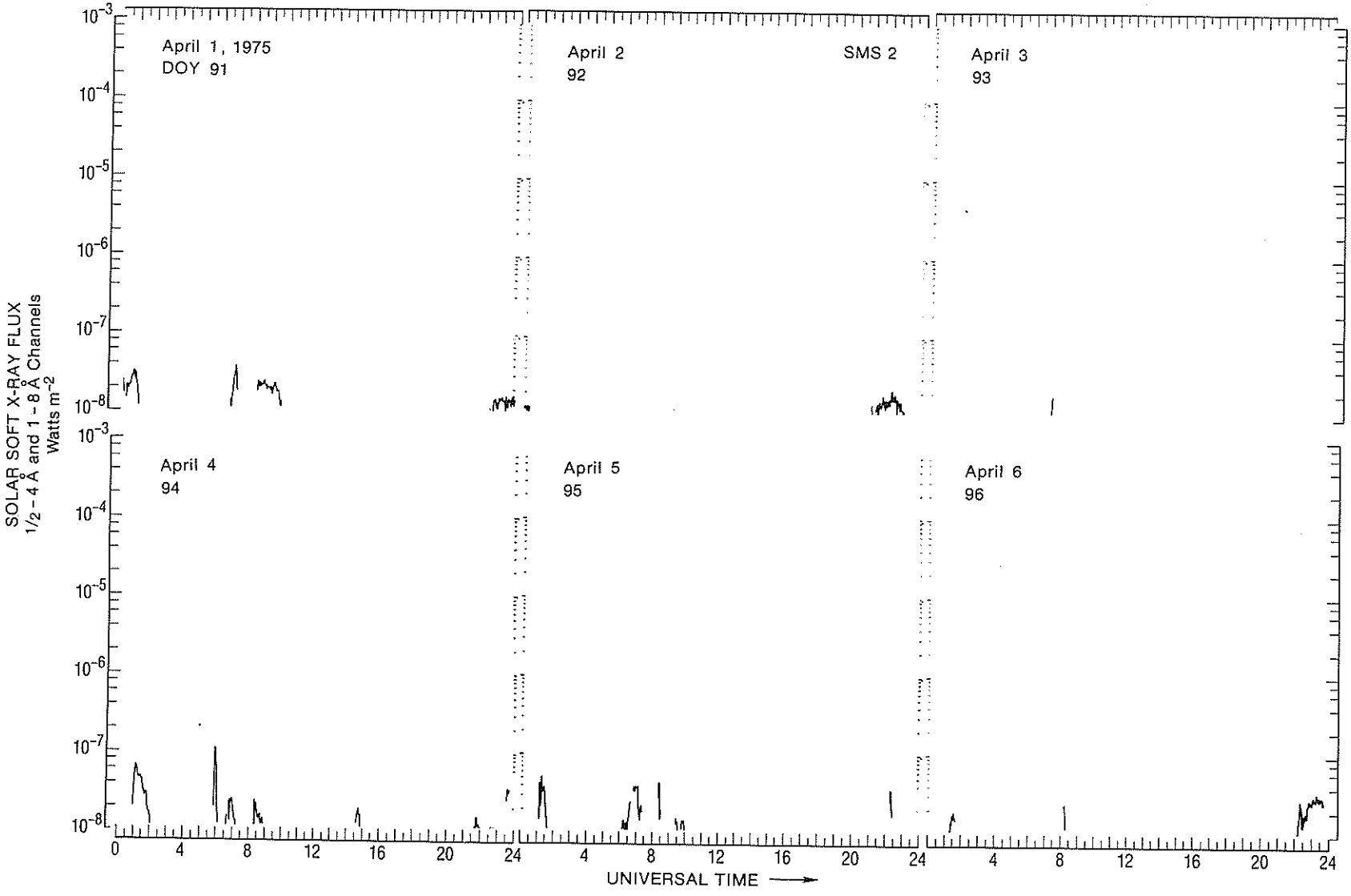


Figure 61. SMS-2 solar X-ray flux for April 1-6, 1975.

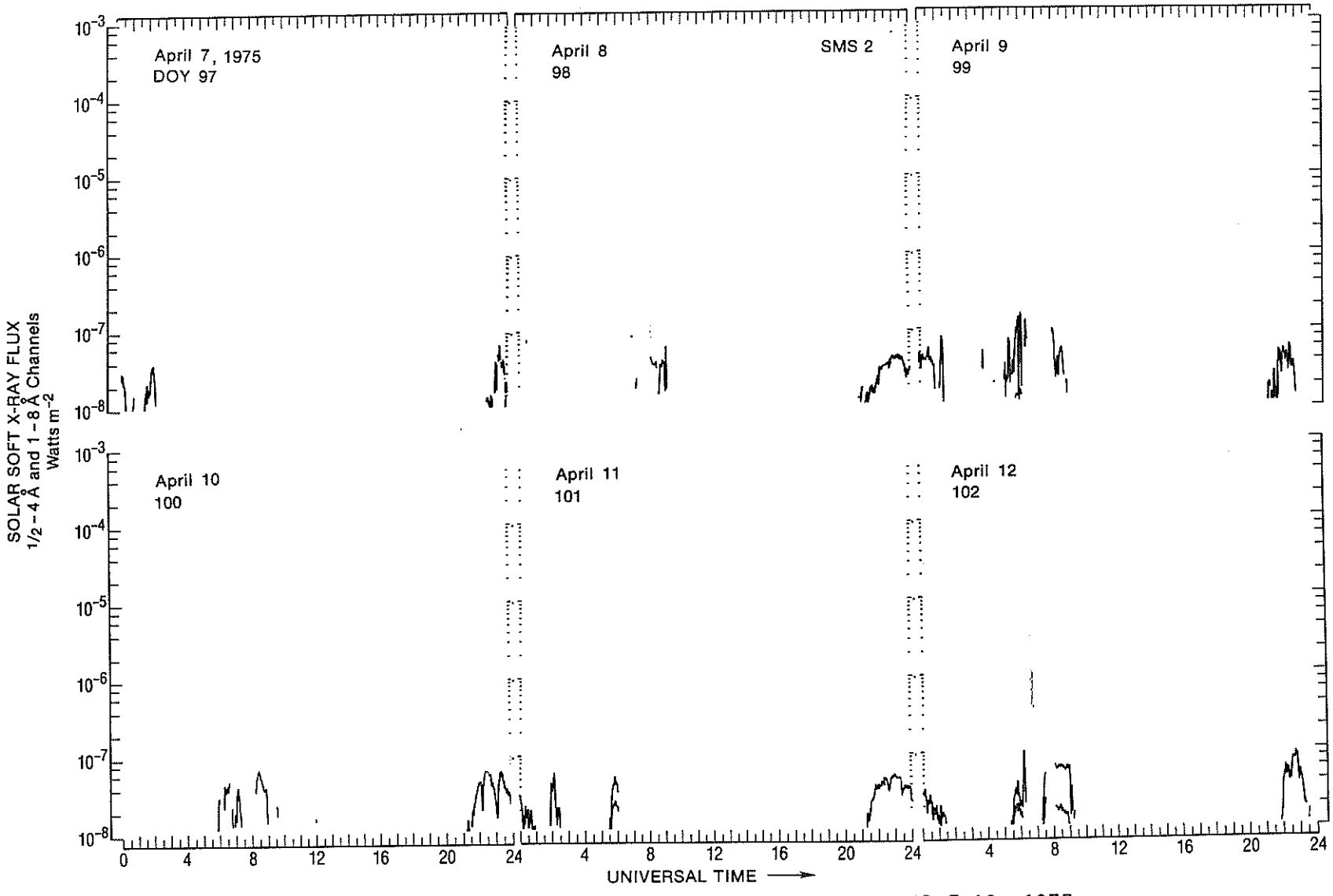


Figure 62. SMS-2 solar X-ray flux for April 7-12, 1975.

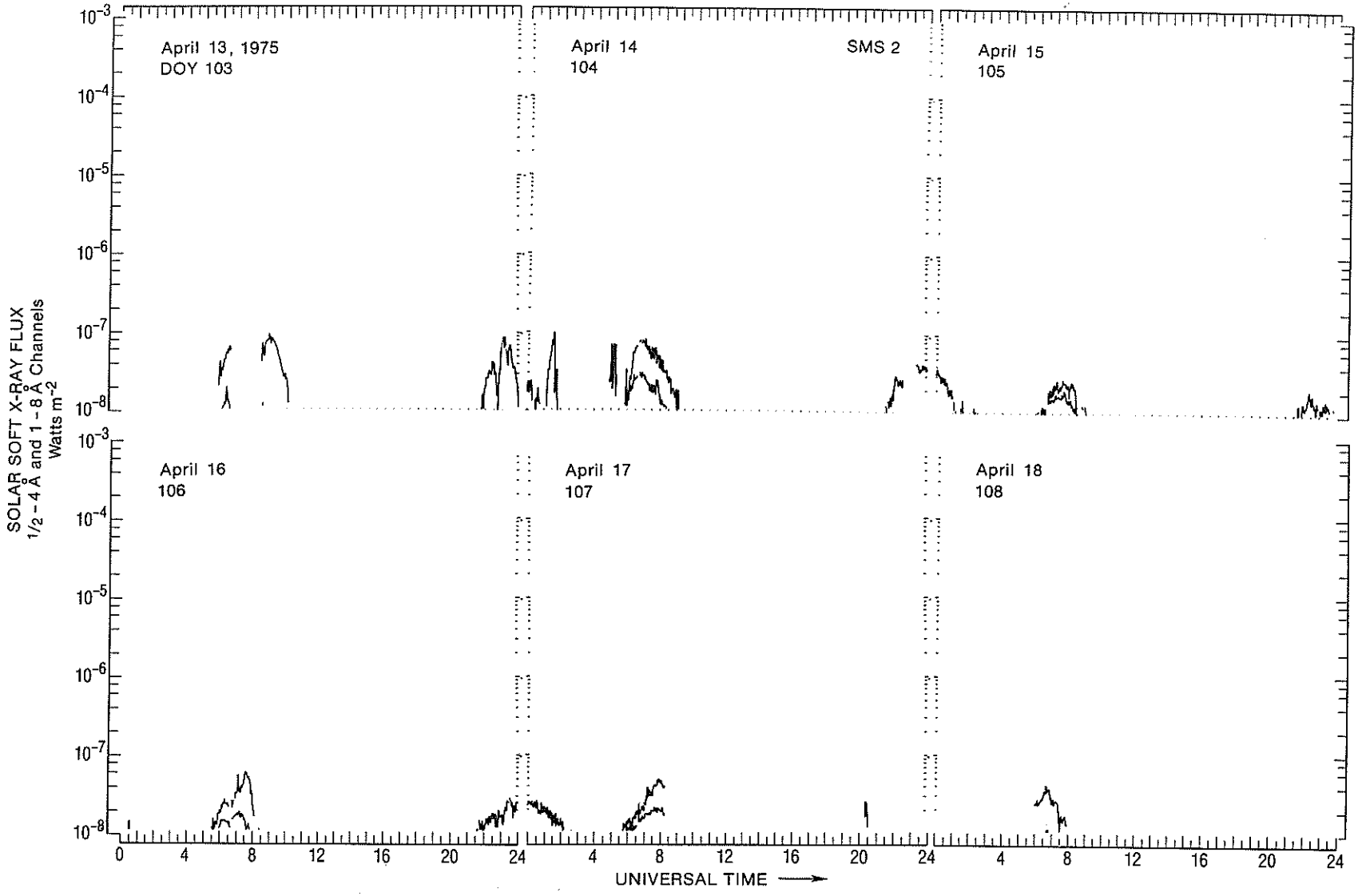


Figure 63. SMS-2 solar X-ray flux for April 13-18, 1975.

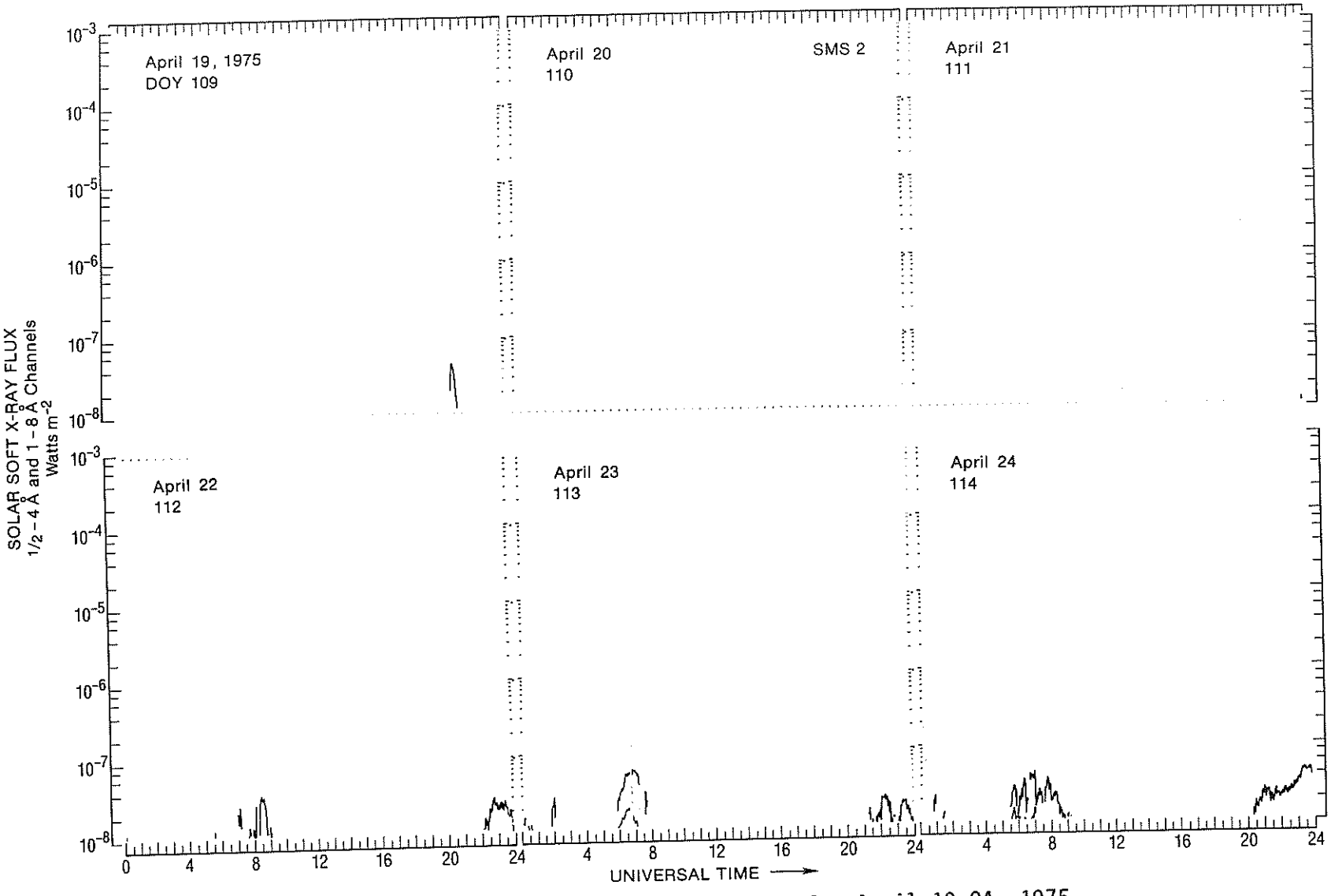


Figure 64. SMS-2 solar X-ray flux for April 19-24, 1975.

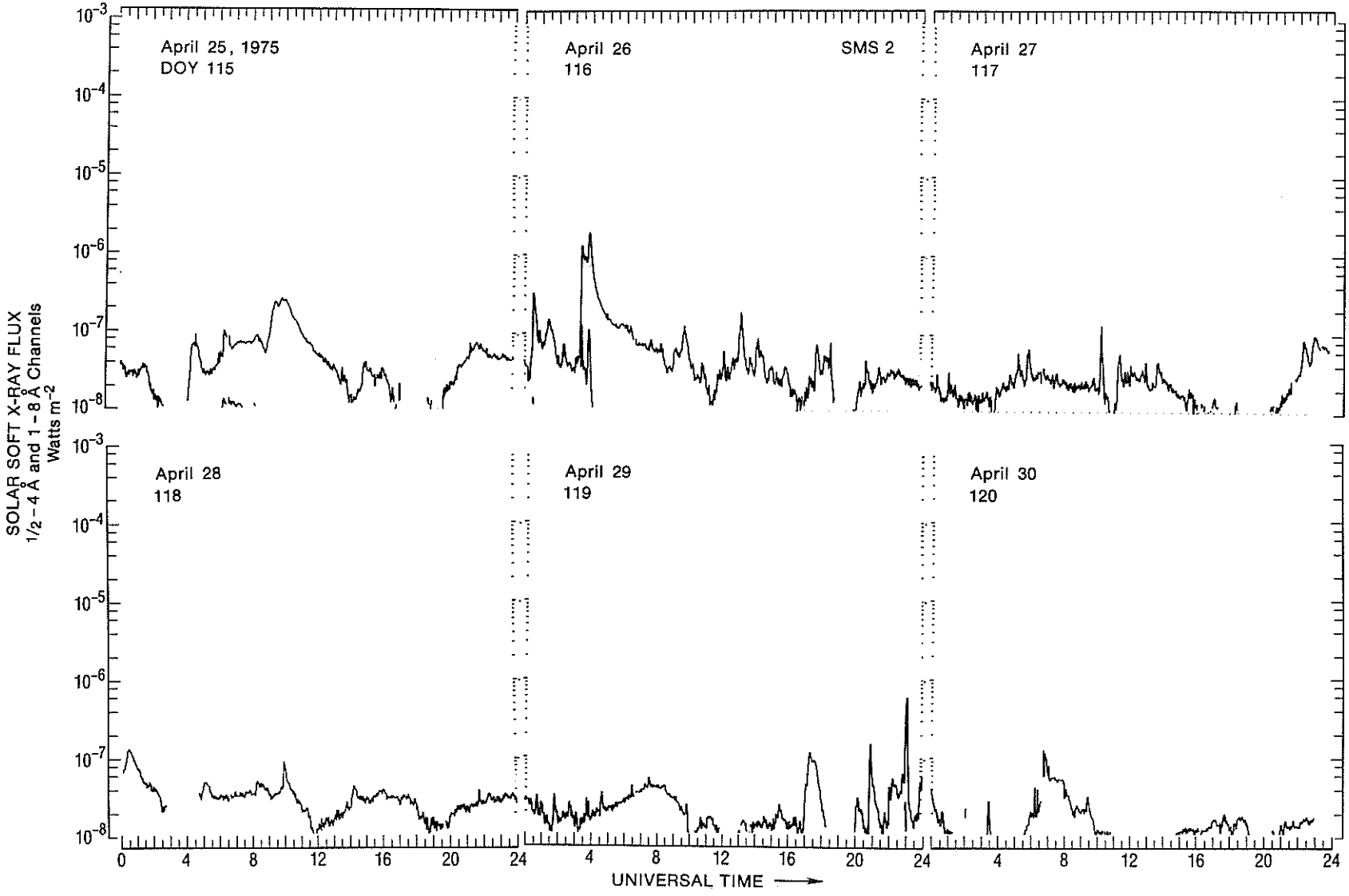


Figure 65. SMS-2 solar X-ray flux for April 25-30, 1975.

2.11 May 1975, SMS-2

2.11.1 Solar Activity Overview

See figures 66-70. The solar X-ray flux continued at the low levels present at the end of April, with a C1 flare on May 8. Data have been found during the large gap in the figure for May 4. The flux was $\lesssim 10^{-7}$ Wm^{-2}, with a microflare with a peak flux of about 8×10^{-7} Wm^{-2} at 1604 UT, May 4. Data also exist on May 9 and 14, but no significant flares were observed. Then the flux decreased slowly to very low flux levels at the end of May.

2.11.2 Missing Data

Calibrations continued at about 0640 and 1940 UT, daily, for about ten minutes each, slipping to 0710 UT on May 7. Major outages in the recorded data occurred during the following periods: 1404 - 1555 UT, May 2; 0709 - 1351 UT, May 9; 2006 - 2206 UT, May 17; 1618 - 2054 UT, May 19; 1504 - 1750 UT, May 20; 2142 - 2232 UT, May 26; 2008 - 2301 UT, May 28; 1900 - 2003 and 2212 - 2302 UT, May 29; and 2300 - 2400 UT, May 31, 1975.

2.12 June 1975, SMS-2

2.12.1 Solar Activity Overview

See figures 71-74. The solar X-ray flux remained very low from May through the first half of June, rising to low intensities during the last third of the month. A C2 flare occurred on June 20 and another one on June 23. These were the high points of activity during June.

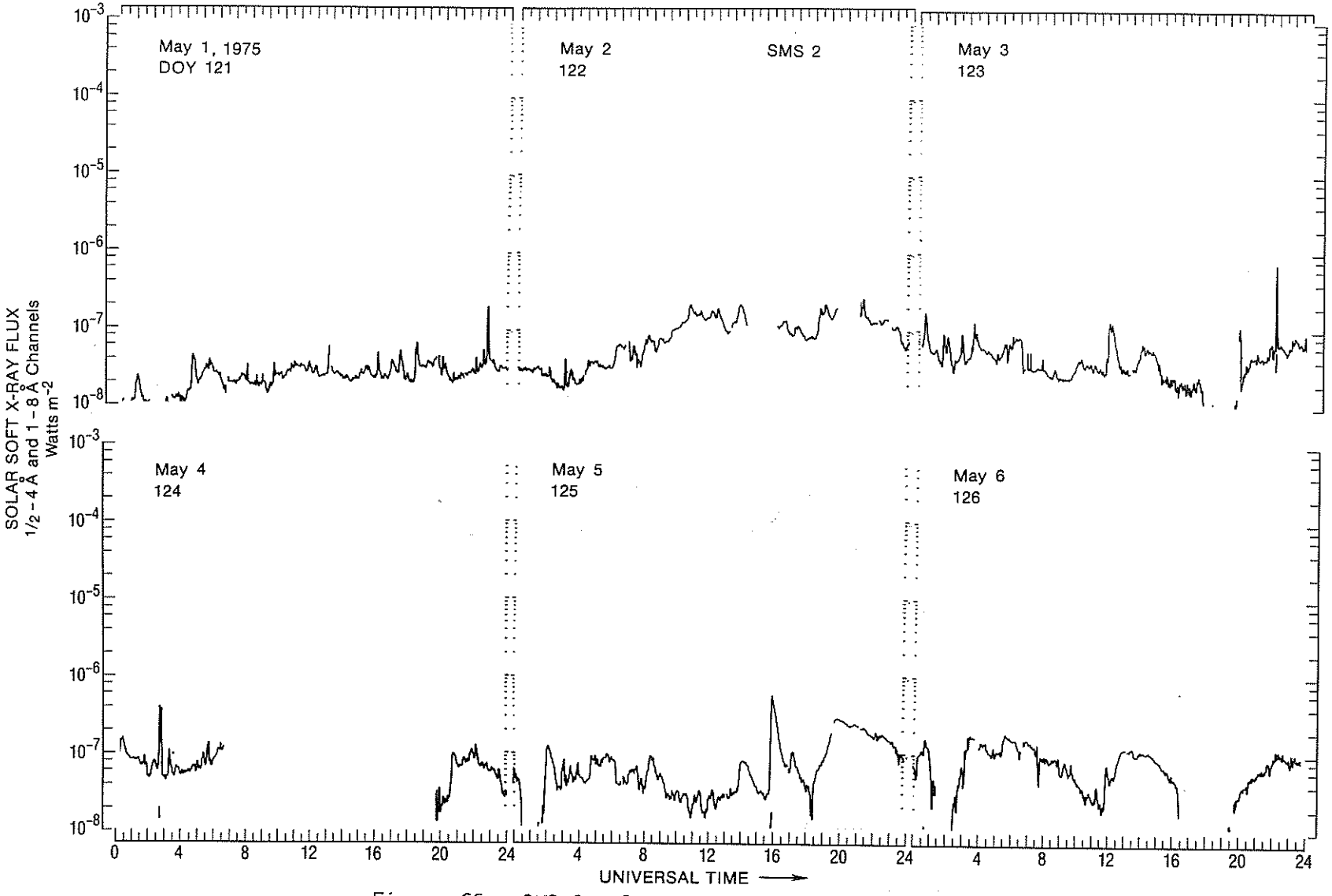
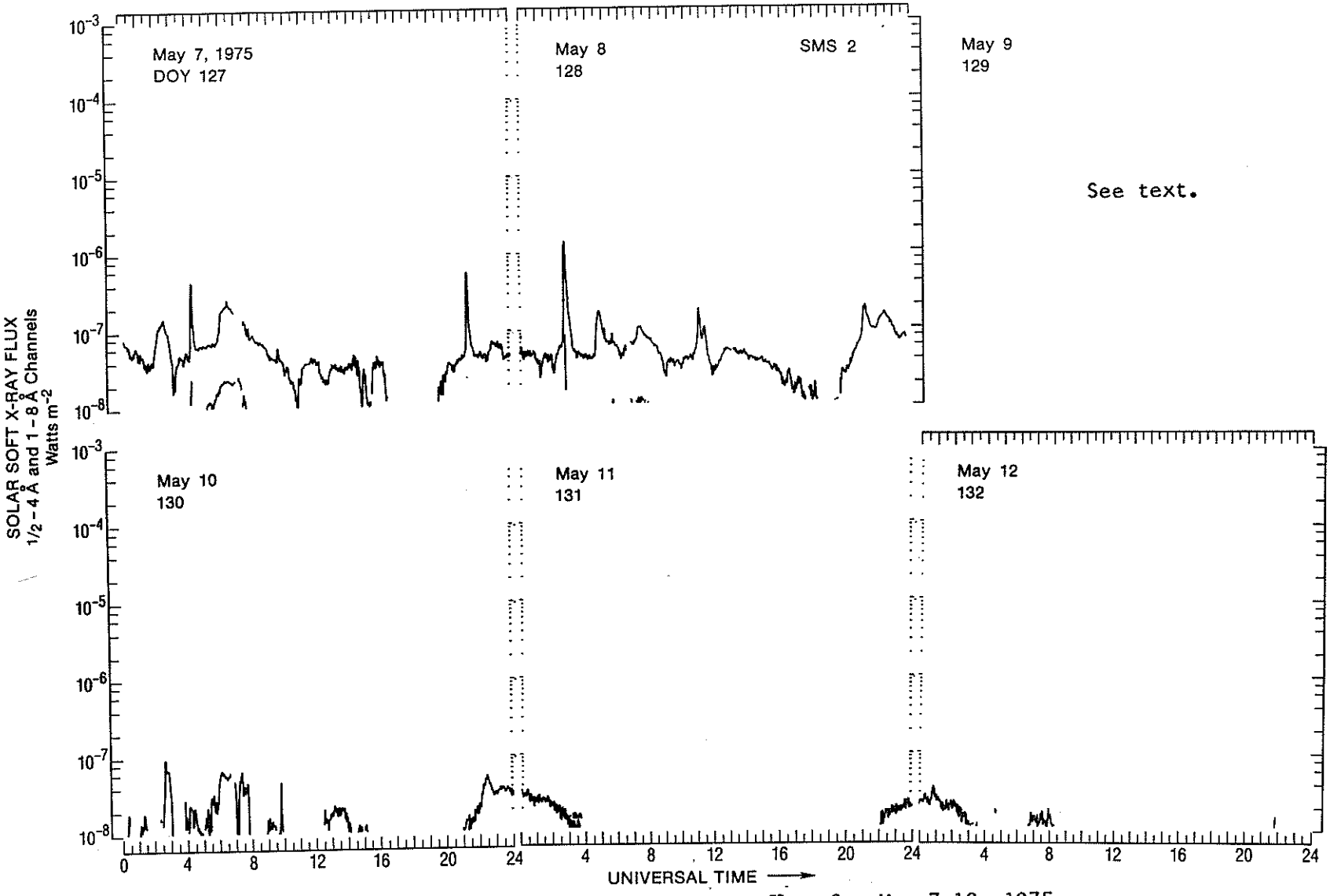


Figure 66. SMS-2 solar X-ray flux for May 1-6, 1975.



See text.

Figure 67. SMS-2 solar X-ray flux for May 7-12, 1975.

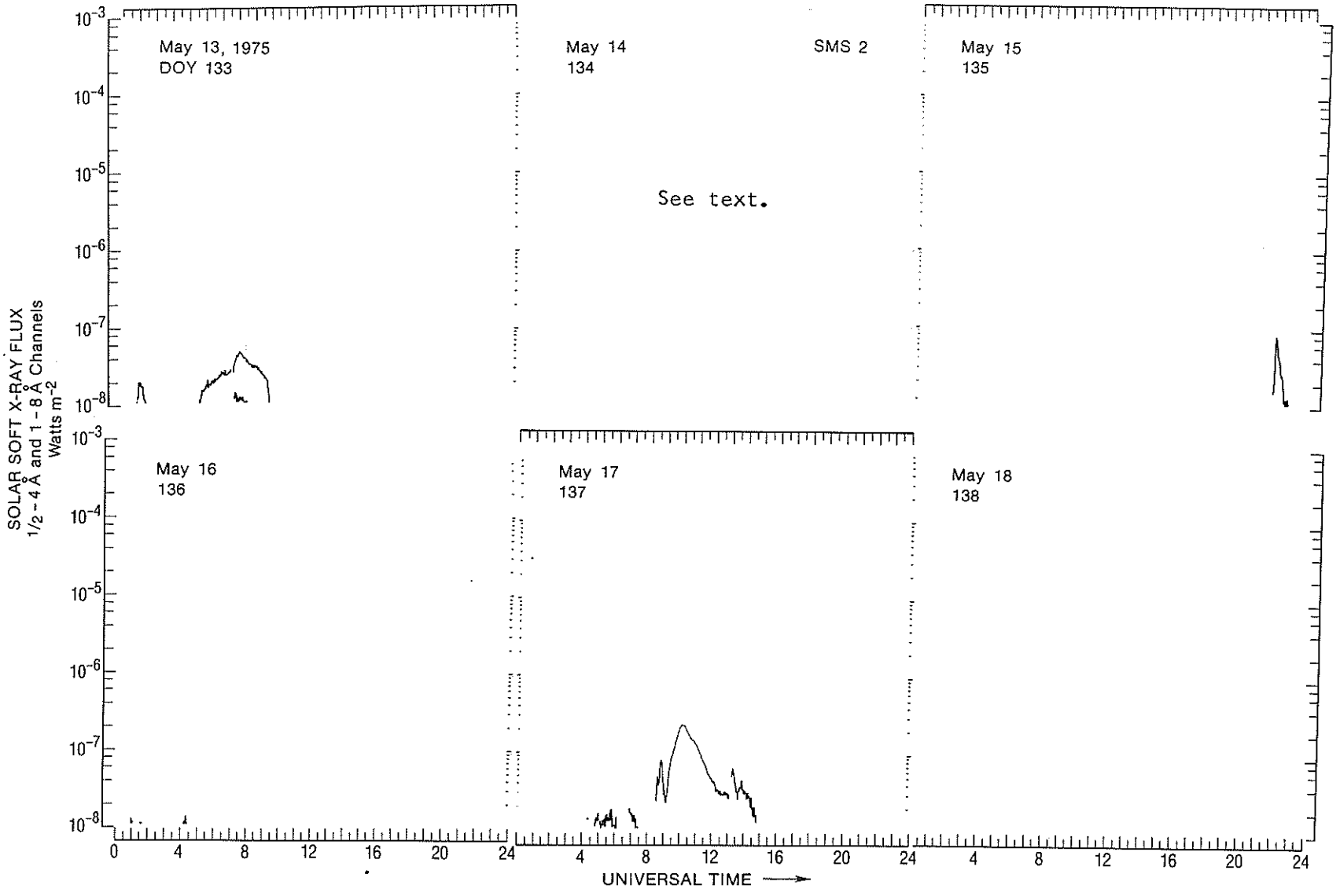


Figure 68. SMS-2 solar X-ray flux for May 13-18, 1975.

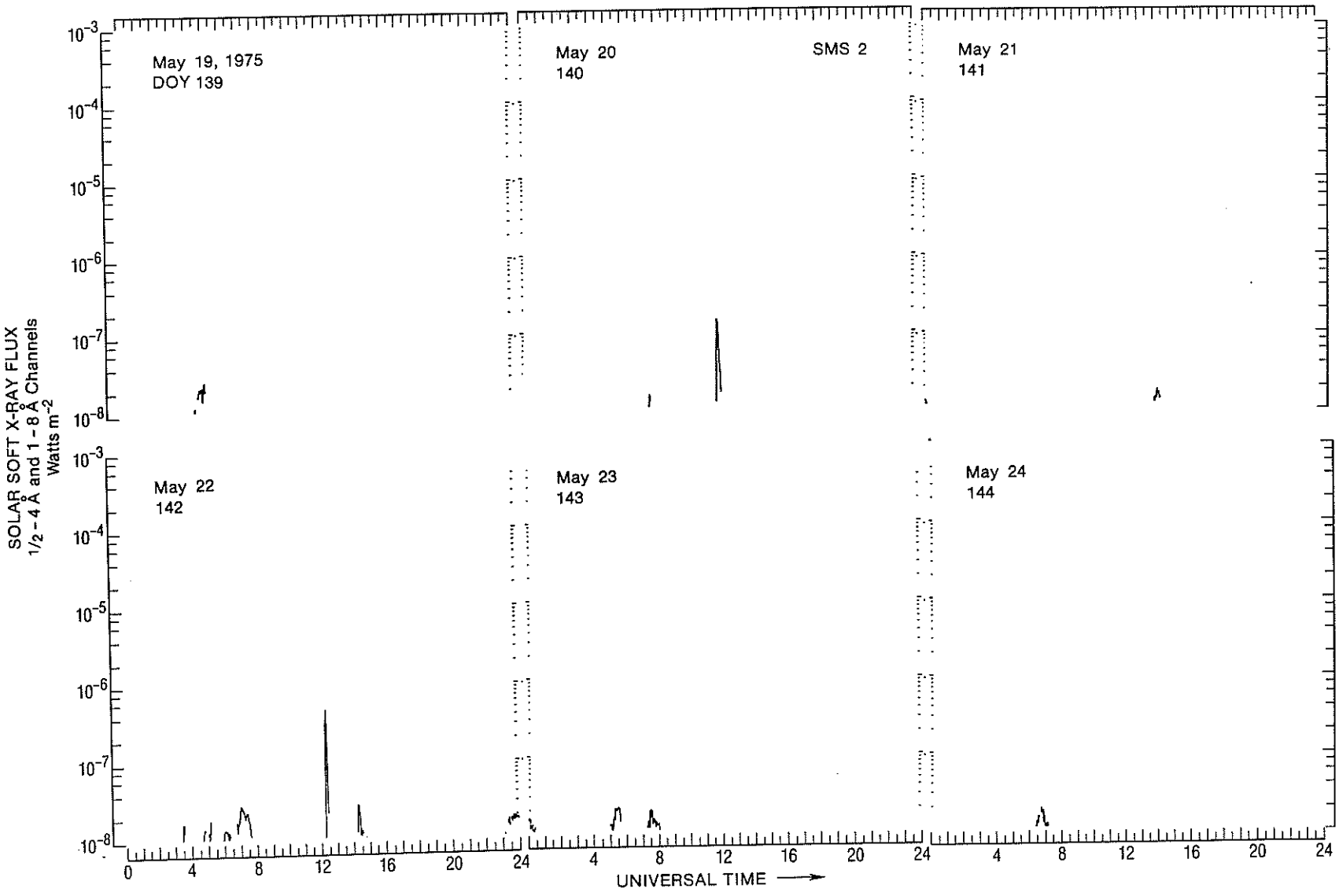


Figure 69. SMS-2 solar X-ray flux for May 19-24, 1975.

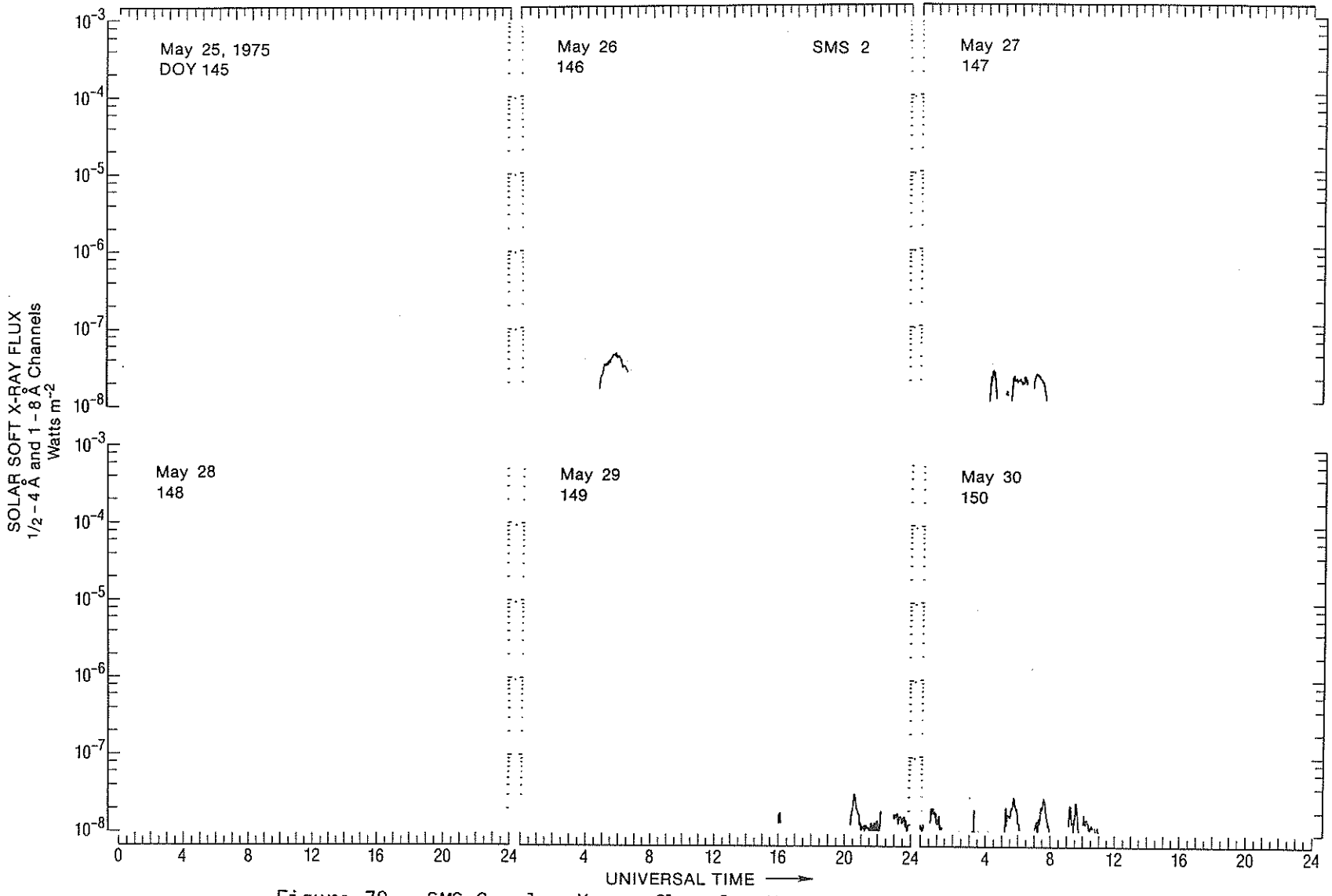


Figure 70. SMS-2 solar X-ray flux for May 25-30, 1975. No figure is shown for May 31, 1975, because the observed 1-8Å X-ray flux was always below 10^{-8} Wm^{-2}.

2.12.2 Missing Data

Calibrations continued at about 0640 and 1940 UT, daily, except it slipped to 2005 UT on June 13 and 2144 UT June 28. Major outages occurred during the following periods: 0042 - 0556 UT and 1933 - 2028 UT, June 4; 1625 - 1750 UT and 2013 - 2122 UT, June 5; 0851 - 1400 UT, June 6; and 1555 UT June 6 to 2400 UT on June 9; 0122 - 0304 UT, June 12; 1117 - 1705 UT, June 13; 2213 UT June 14 to 0112 UT June 15; 1906 UT June 16 to 0000 June 20; 0045 - 0218 UT, June 20; 2215 UT June 20 to 0044 UT, 0046 - 0956 UT, and 1058 - 1633 UT, June 21; 1823 - 2225 UT, June 27; 1921 - 2012 UT and 2100 - 2400 UT, June 30. Data exist on June 27, when the flux was usually in the range 1 - 2 x 10^{-7} Wm^{-2}. An outage lasting several minutes occurred daily just after 1300 UT. Scattered small outages lasting typically less than a minute occurred after 1700 UT, June 21, through June 27. During the outage of SMS-2 data from 1906 UT June 16 to 0000 UT June 20, no significant bursts were recorded by SMS-1.

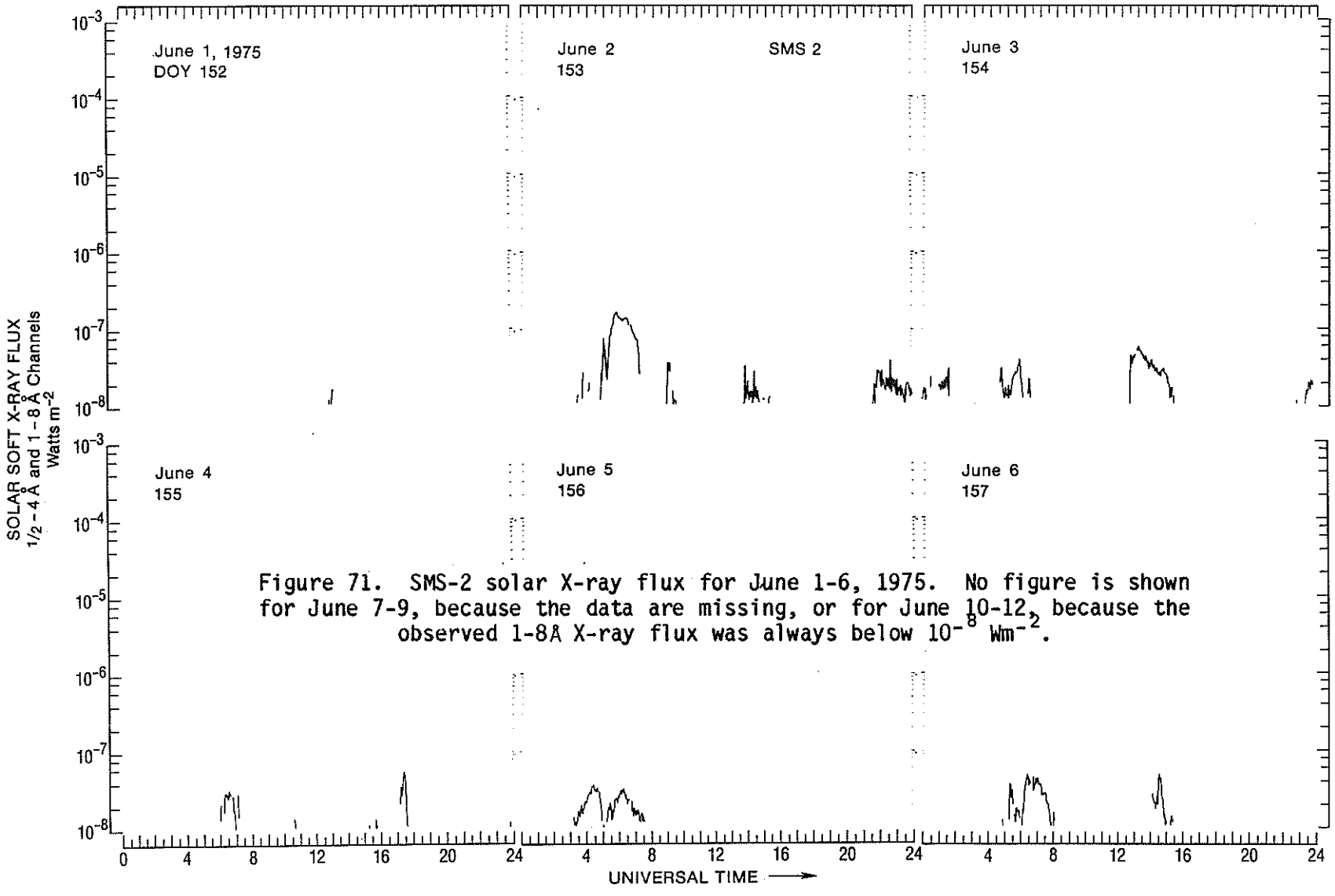


Figure 71. SMS-2 solar X-ray flux for June 1-6, 1975. No figure is shown for June 7-9, because the data are missing, or for June 10-12, because the observed 1-8Å X-ray flux was always below 10^{-8} Wm^{-2}.

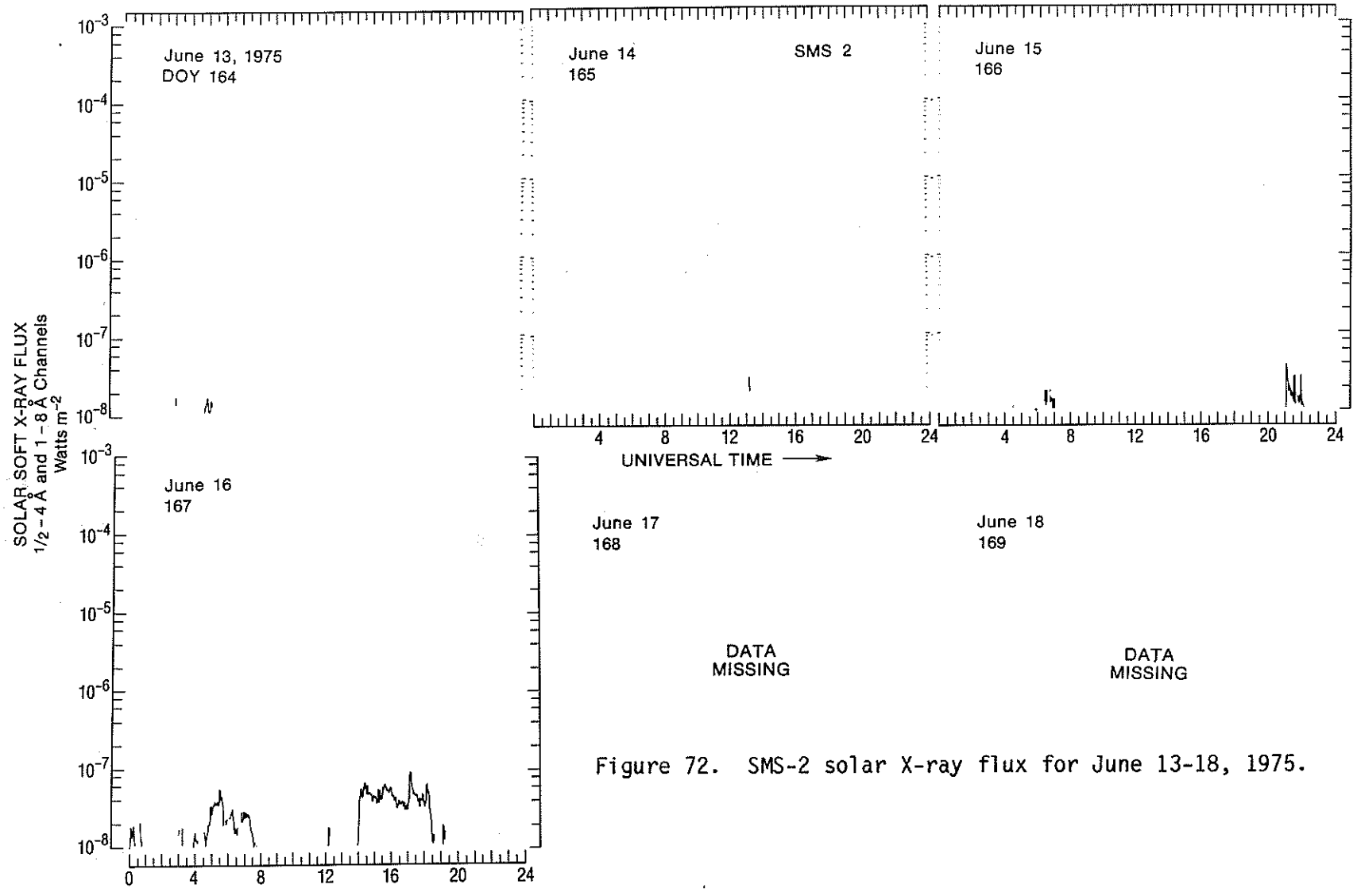


Figure 72. SMS-2 solar X-ray flux for June 13-18, 1975.

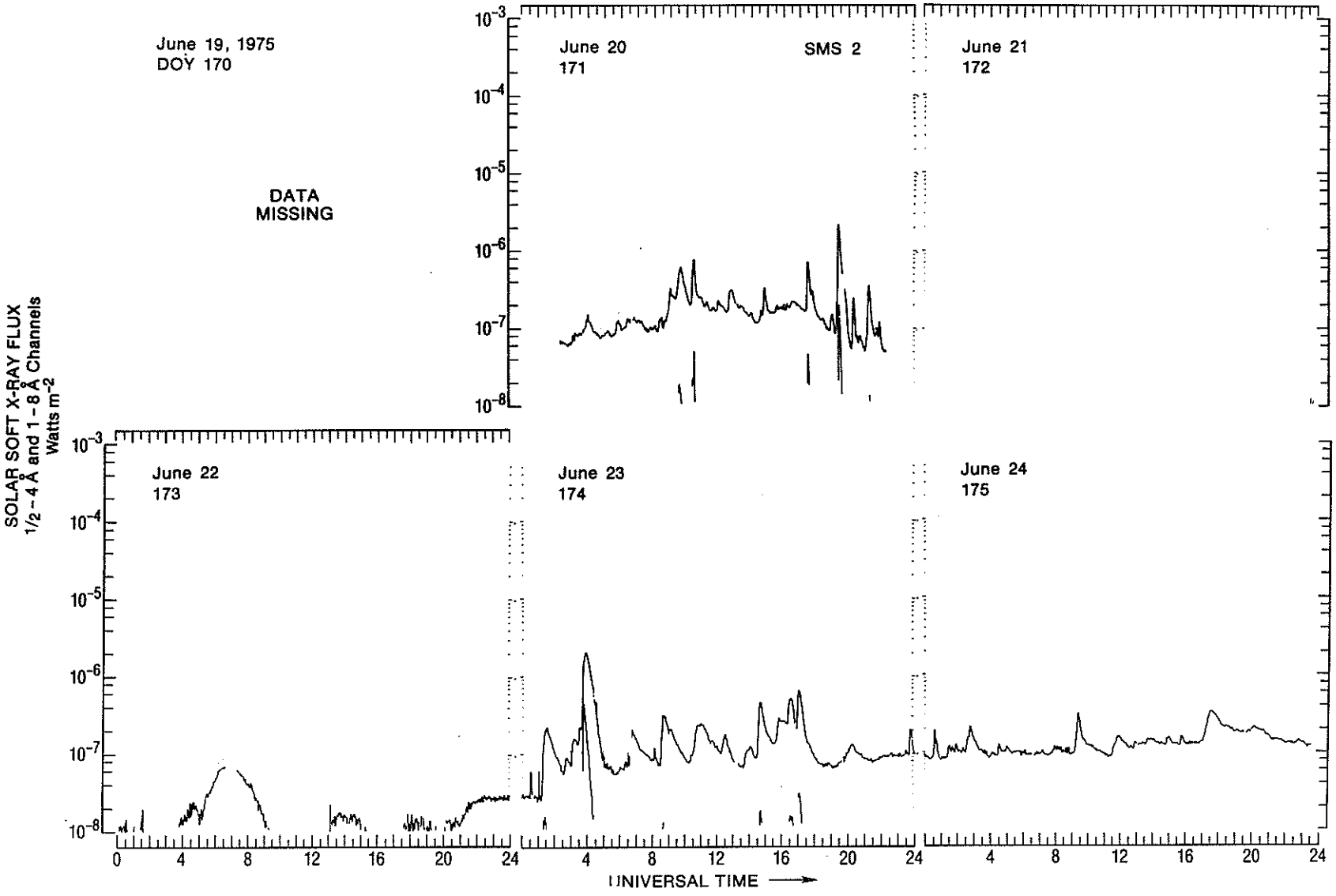


Figure 73. SMS-2 solar X-ray flux for June 19-24, 1975.

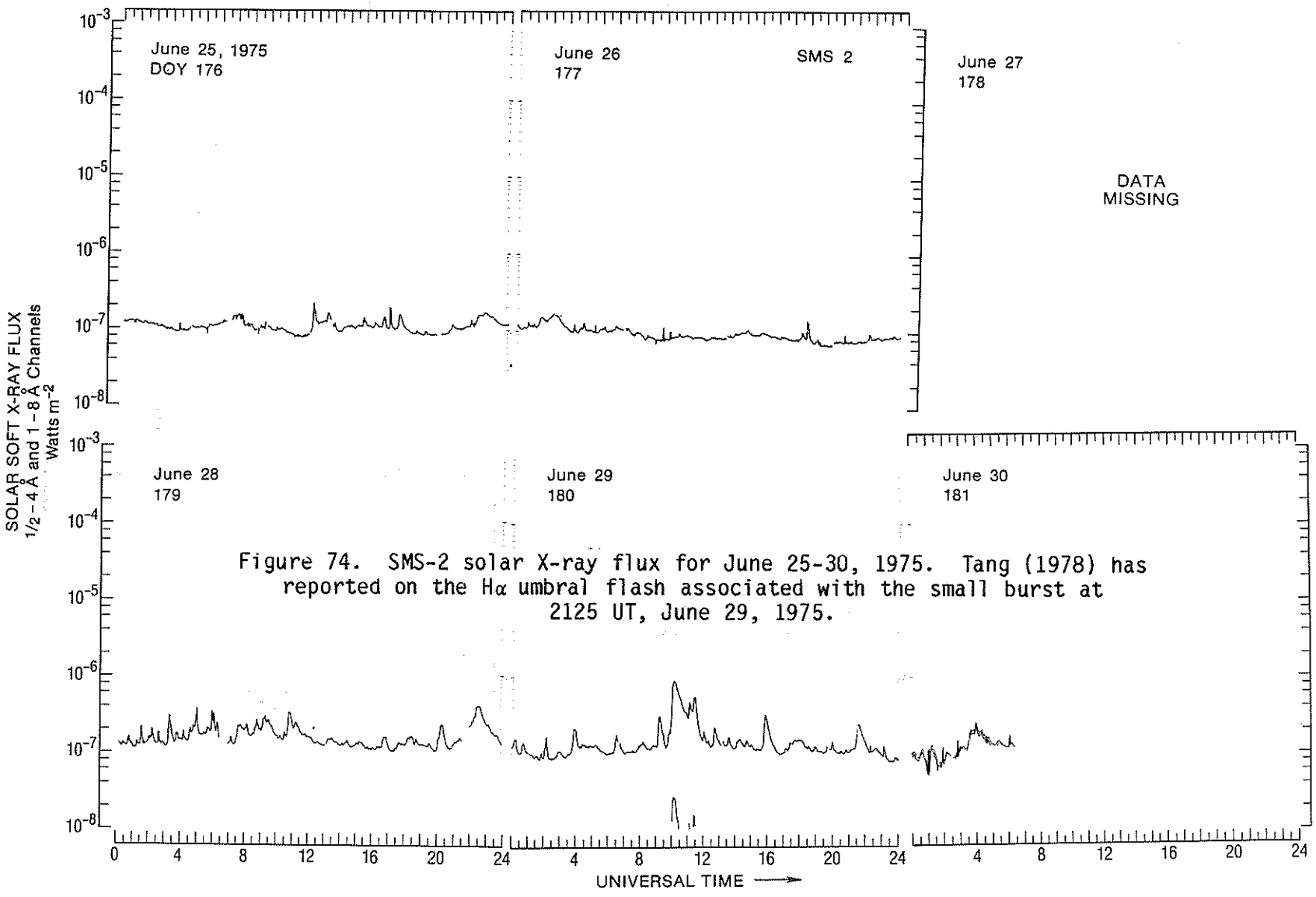


Figure 74. SMS-2 solar X-ray flux for June 25-30, 1975. Tang (1978) has reported on the Hα umbral flash associated with the small burst at 2125 UT, June 29, 1975.

2.13 July 1975, SMS-2

2.13.1 Solar Activity Overview

See figures 75-78. The solar soft X-ray flux continued at low flux levels at the start of July, with scattered small flares during July 2-9, decreasing to the monthly low on July 10, rising again on July 11 with a C1 flare at 0915 UT, near 10^{-7} Wm^{-2} for the rest of the month. Another C1 flare occurred at 2345 UT on July 25.

2.13.2 Missing Data

Calibrations occurred for about ten minutes near 0640 and 1940 UT daily. Major outages occurred during the following periods: 0000 - 0207 UT and 2030 - 2333 UT, July 1; 2215 - 2354 UT, July 3; 1911 - 2208 UT, July 4; 2147 UT July 7 to 0045 UT July 8; 2328 UT July 8 to 0108 UT July 9; 2112 UT July 9 to 0139 UT July 10; 2338 UT July 10 to 0302 July 11; 1730 UT July 11 to 0117 UT July 18; 2124 - 2235 UT, July 18; 0000 - 0132 UT, July 19; 2047 - 2125 UT, July 21; 2126 - 2308 UT, July 22; 2035 - 2202 UT, July 23; 2326 July 23 to 0033 UT July 24; 0134 - 0255 UT, July 24; 1705 UT July 24 to 1355 UT July 25; 1551 - 1709 UT, July 29; and 2100 UT July 29 to 2400 UT July 31. Data have been found for several of the outages in the figures of July data. During the gap late on July 2, the 1-8Å X-ray flux was in the range 3 to 5 x 10^{-8} Wm^{-2}. During the large gap on July 5, the flux was 4 to 8 x 10^{-8} Wm^{-2}. During midday on July 7, the flux was 5 to 8 x 10^{-8} Wm^{-2}. Most of the time during the periods 1000 - 1300 UT and 1730 - 2100 UT on July 10, the flux was below 10^{-8} Wm^{-2}.

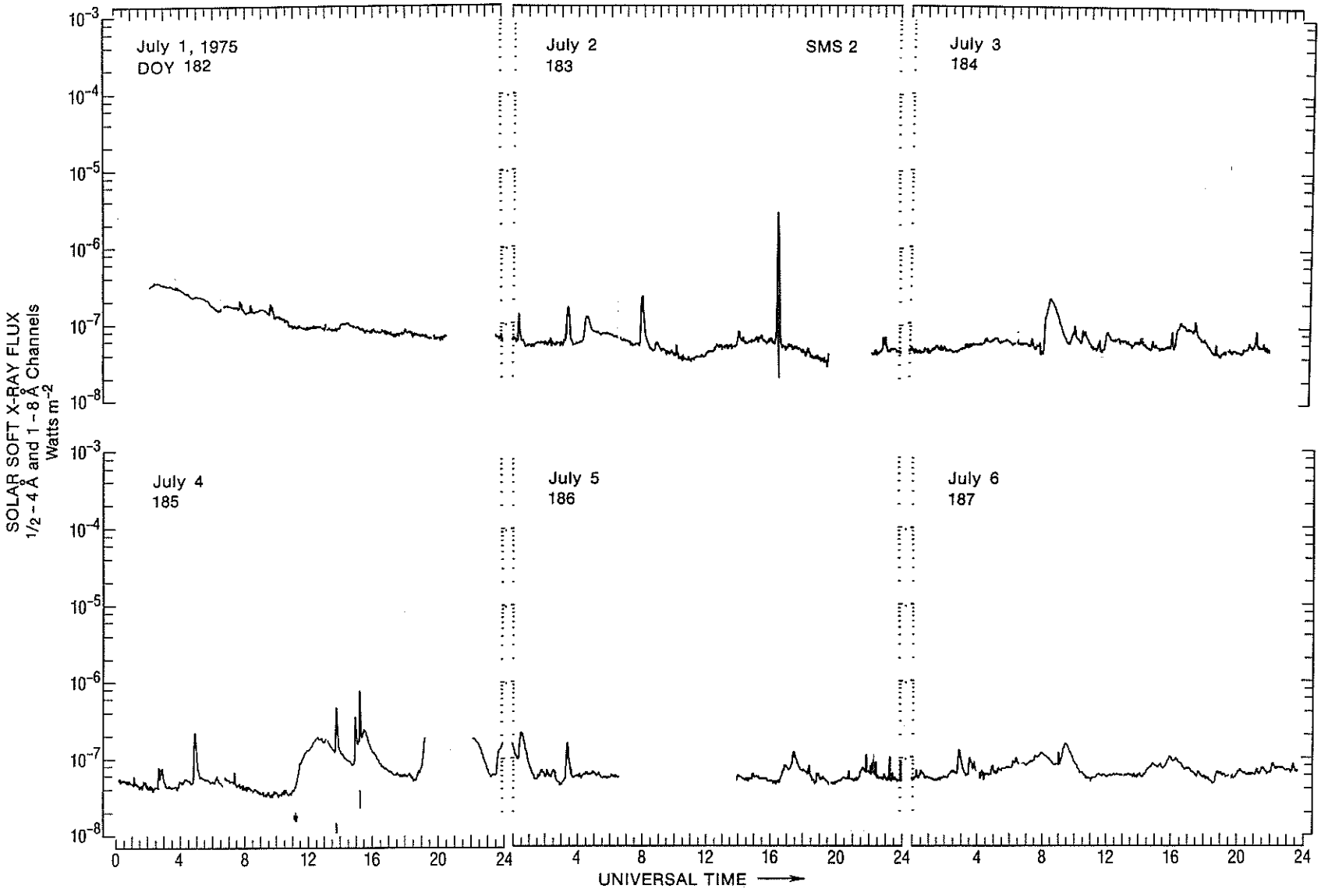


Figure 75. SMS-2 solar X-ray flux for July 1-6, 1975.

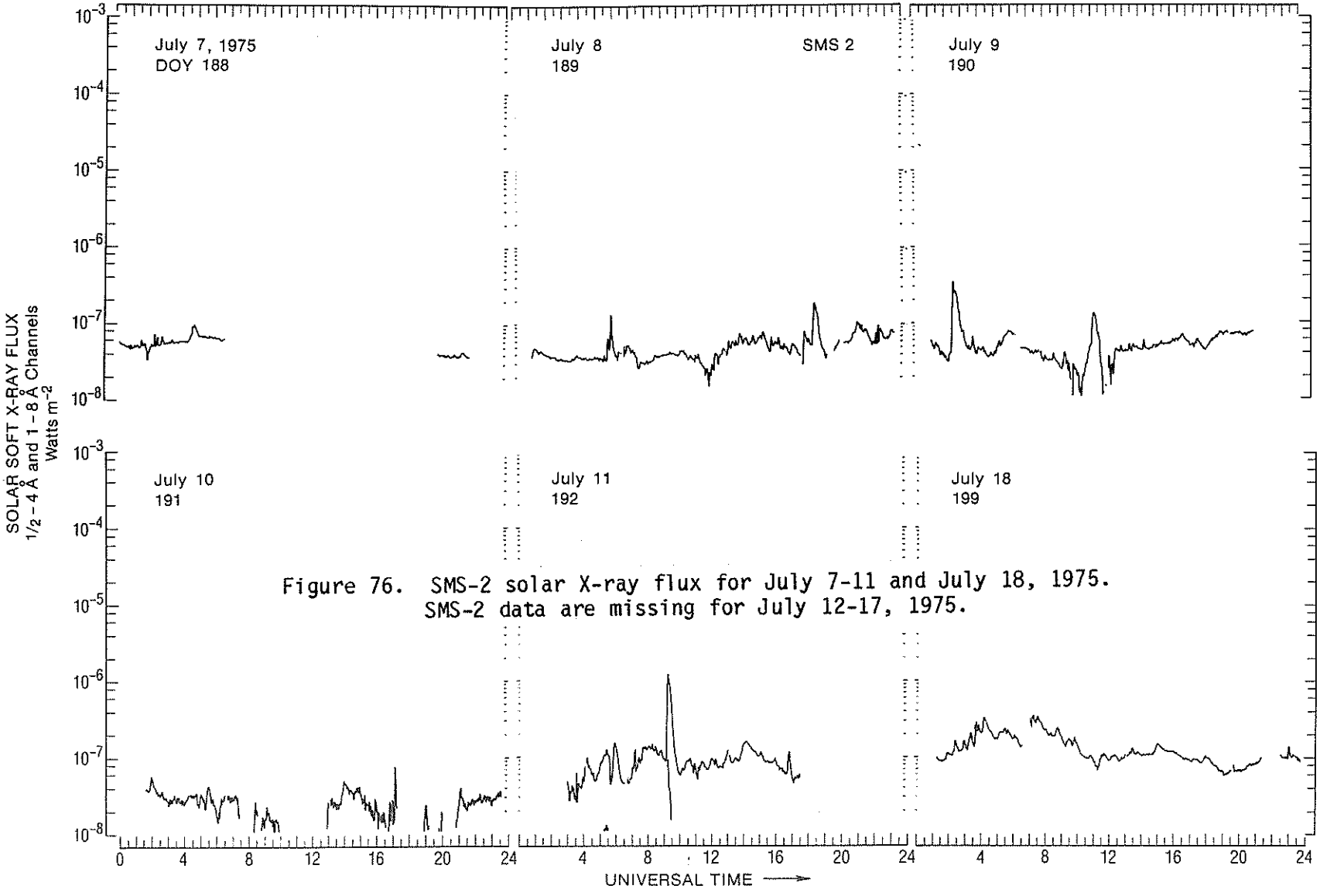


Figure 76. SMS-2 solar X-ray flux for July 7-11 and July 18, 1975. SMS-2 data are missing for July 12-17, 1975.

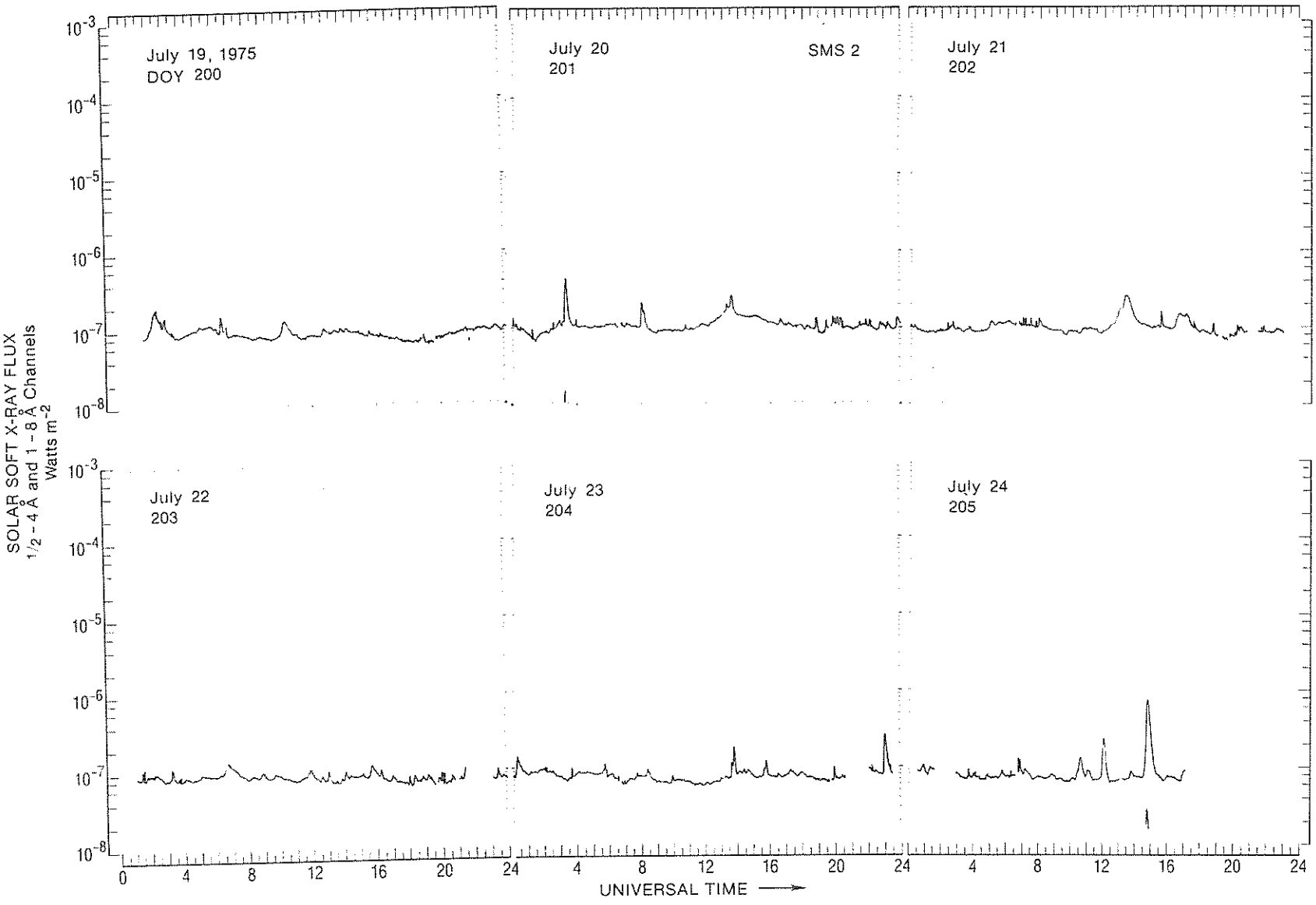


Figure 77. SMS-2 solar X-ray flux for July 19-24, 1975.

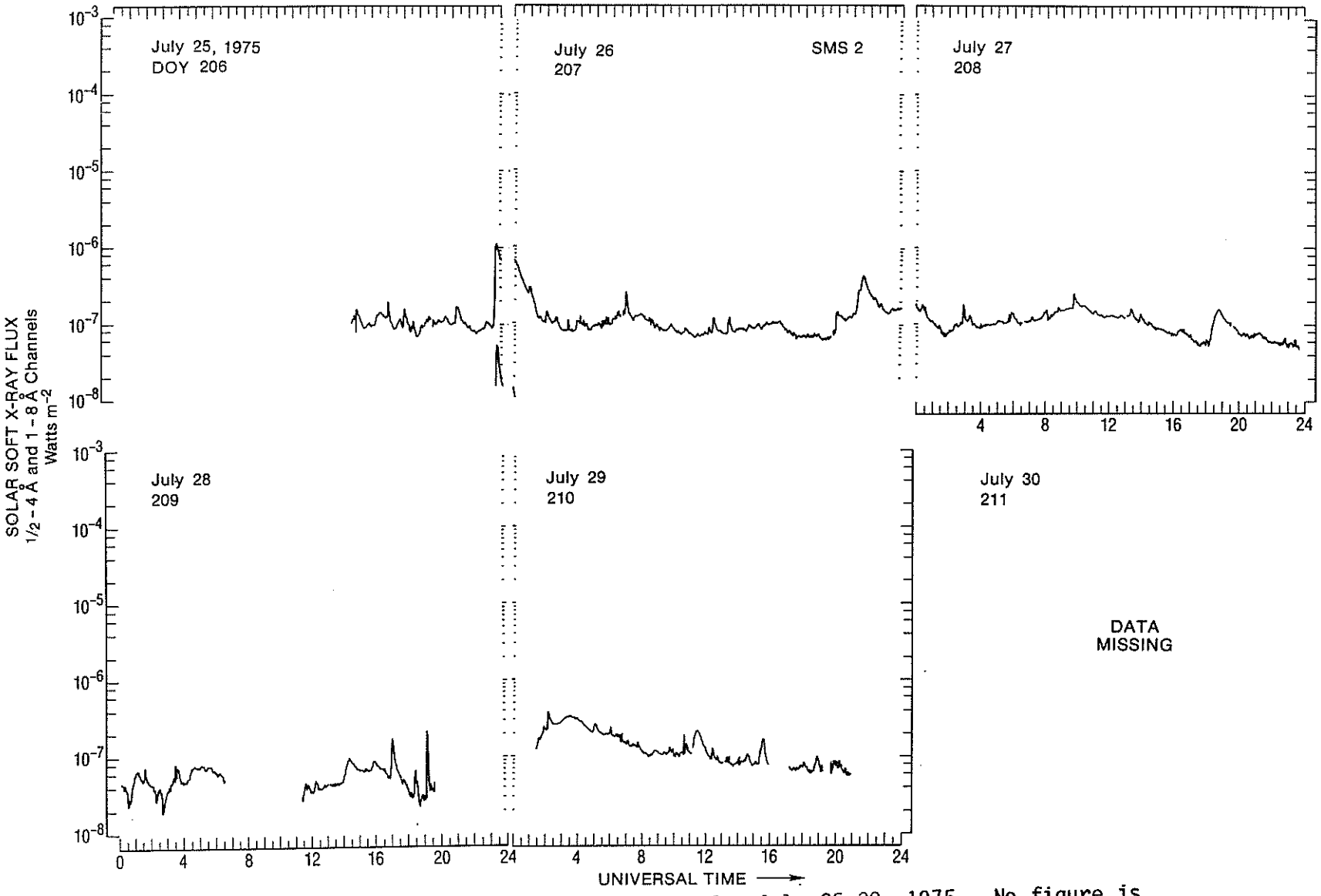


Figure 78. SMS-2 solar X-ray flux for July 25-30, 1975. No figure is shown for July 30 or 31 because the data are now missing.

2.14 August 1975, SMS-2

2.14.1 Solar Activity Overview

The X-ray flux ranged from moderate to high non-flare levels with a flurry of solar flares during the first half of August. Three M-class flares occurred on August 2, two M flares on August 3, two M flares on August 10, two more plus an X1 flare August 21, and six M-class flares on August 22. The flux dropped to low values on August 18 and 19, followed by the second active period of August 20-28. This is the most active period since November 1974. See figures 85-89.

2.14.2 Outstanding Events

An X1 X-ray burst occurred at 1522 UT on August 21, which was the peak of this round of high solar activity. See figure 84a. The rise time of this burst was fairly fast (10 - 90% rise time ~ 2 minutes). The flare of 0119 UT on August 22, was measured to have a 1-8Å peak flux of about 0.9×10^{-4} Wm^{-2} (M9) by SMS-2, but was measured as 1.0×10^{-4} Wm^{-2} (X1) by SMS-1. Its 10-90% rise time was even faster, a little over one minute.

2.14.3 Missing Data

SMS-2 data have been found for the gap on August 1 in figure 85, where a C1 flare occurred at 0744 UT and a C2 flare at 1059 UT. SMS-2 data also exist during the gap near 0700 UT on August 2 in figure 85 that just show the rise of the flare near 0800 UT. SMS-2 data have also been found during the small gap near 2400 UT on August 3, that simply show the continued slow decay of the flare near 2230 UT. Major outages occurred during the following periods: 1542 UT August 4 to 0100 UT August 8; 0916 - 1420 UT, August 9; 0126 - 0327 and 1441 - 1528 UT, August 10; 0800 - 2125, 2138 - 2208 and 2310 - 2352 UT, August 11; 0849 - 1351 UT, August 13; 2115 - 2221 UT, August 16; 1748 - 2055 and 2246 - 2348 UT, August 18; 1723 UT August 22 to 1433 UT August 25; 1158 - 1234 UT, August 27; 2221 - 2324 UT, August 29; and 2300 - 2400 UT, August 31. Data have been found for August 14. A C3 X-ray flare occurred at 0115 UT, a C1 at 0513 UT, C7 spike burst at 0942 UT, C5 flare at 1043 UT with a

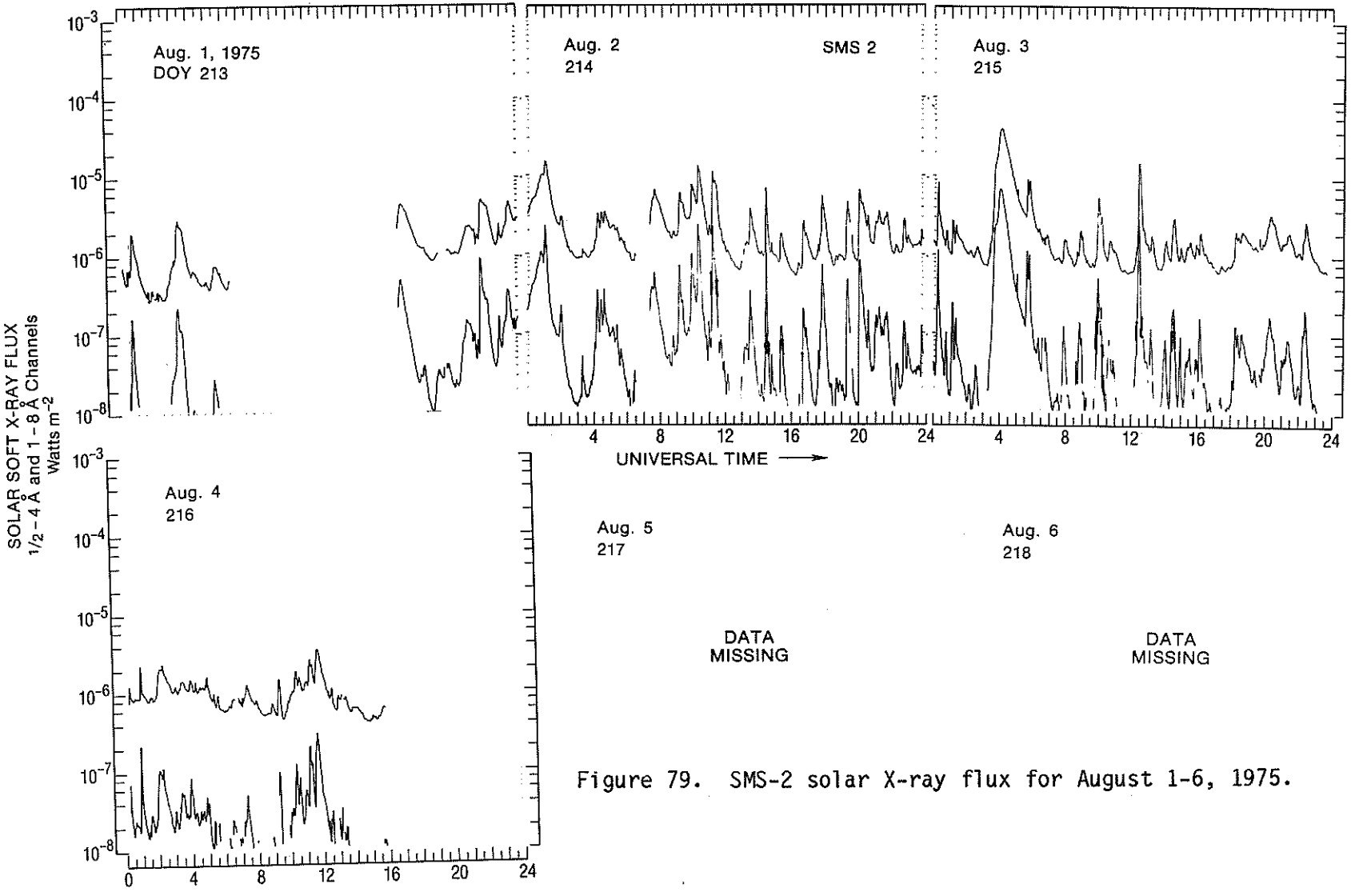


Figure 79. SMS-2 solar X-ray flux for August 1-6, 1975.

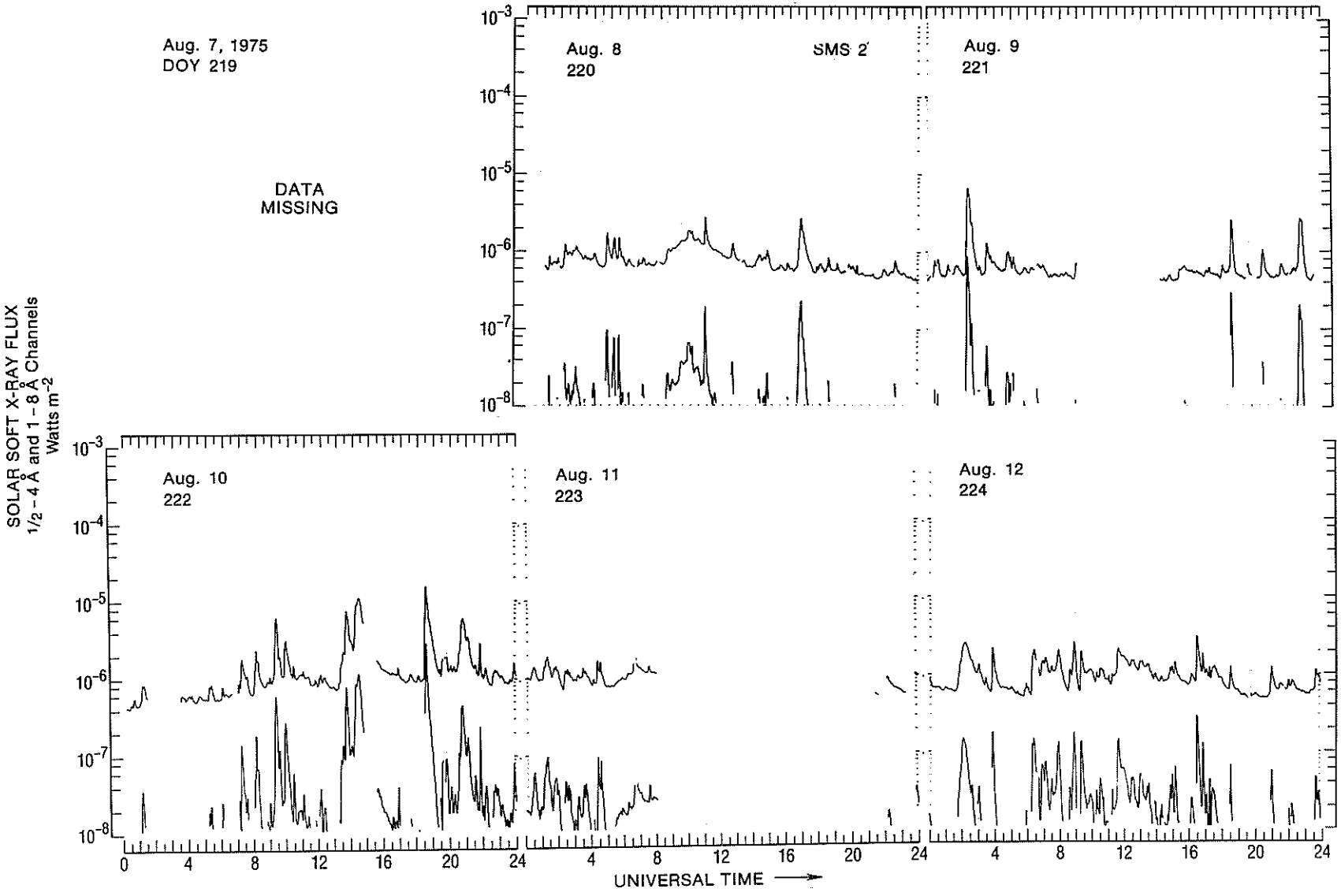


Figure 80. SMS-2 solar X-ray flux for August 7-12, 1975.

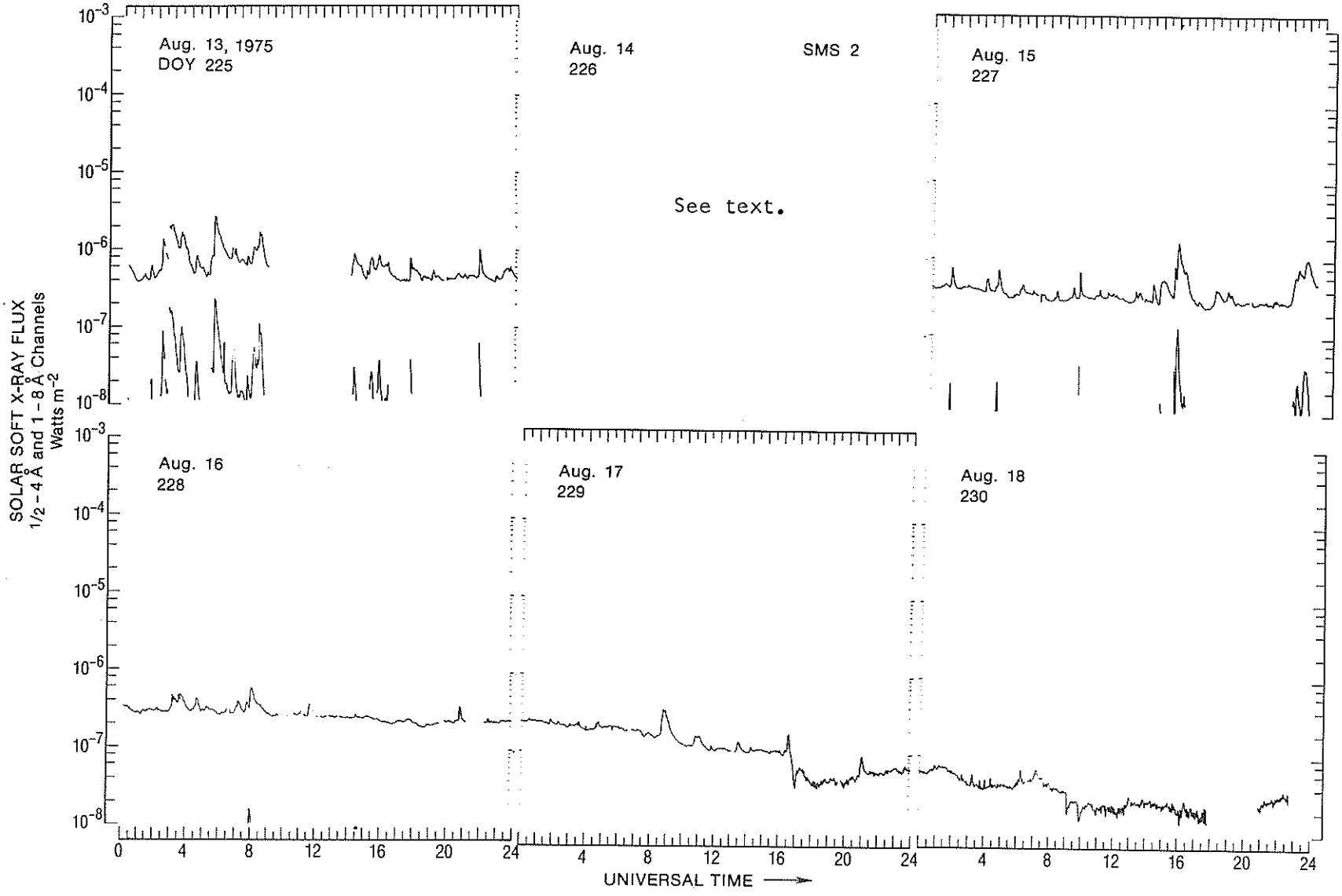


Figure 81. SMS-2 solar X-ray flux for August 13-18, 1975.

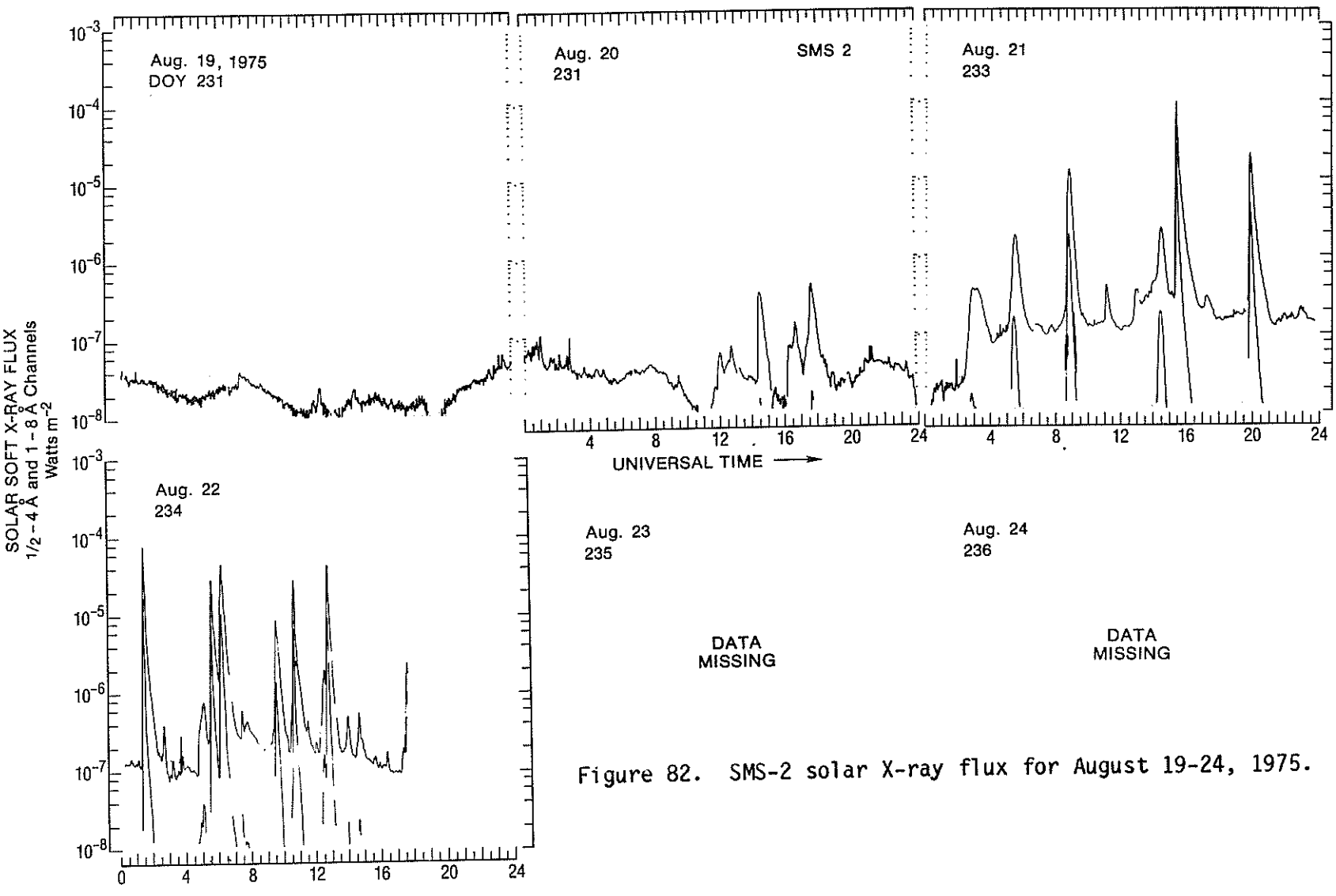


Figure 82. SMS-2 solar X-ray flux for August 19-24, 1975.

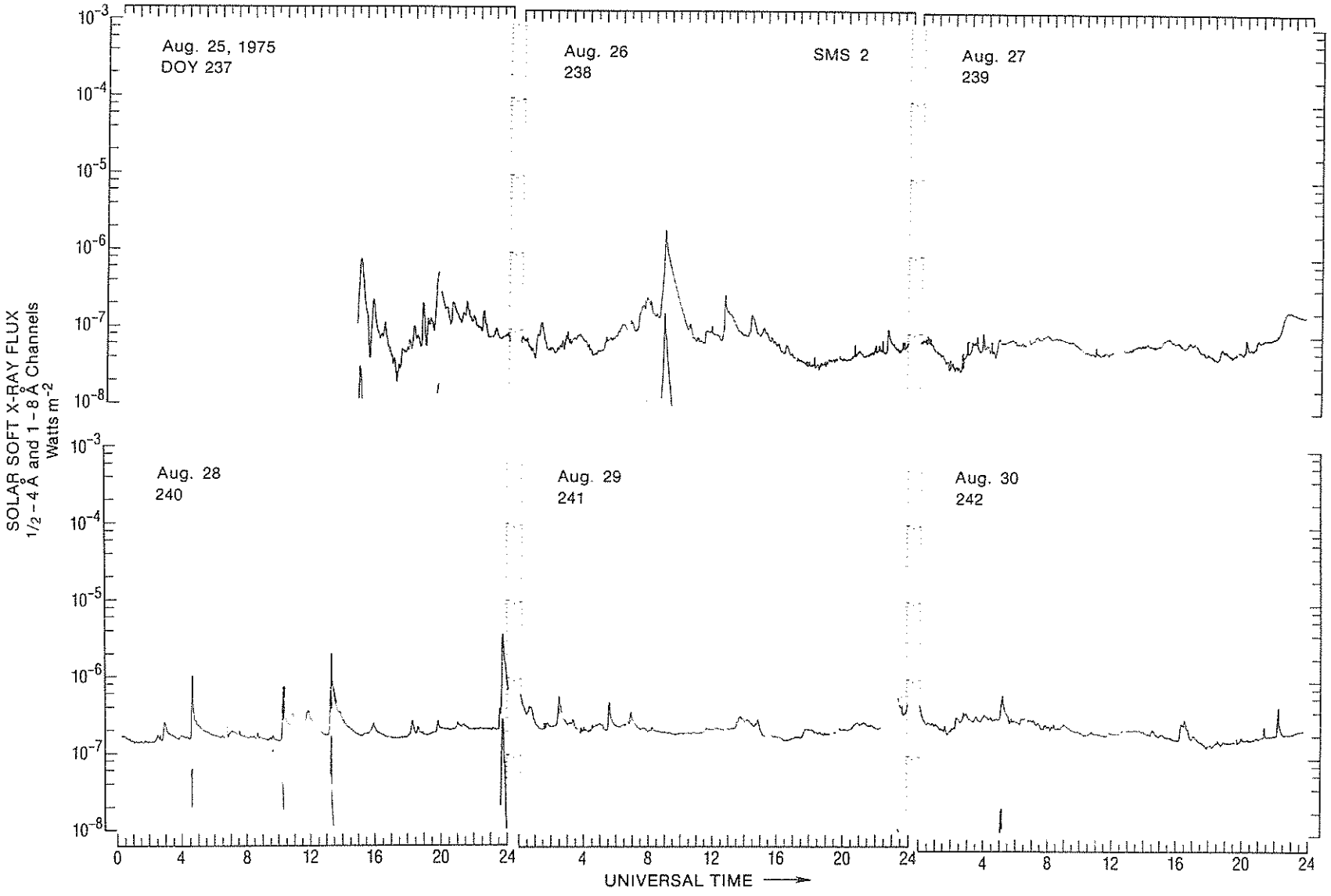


Figure 83. SMS-2 solar X-ray flux for August 25-30, 1975.

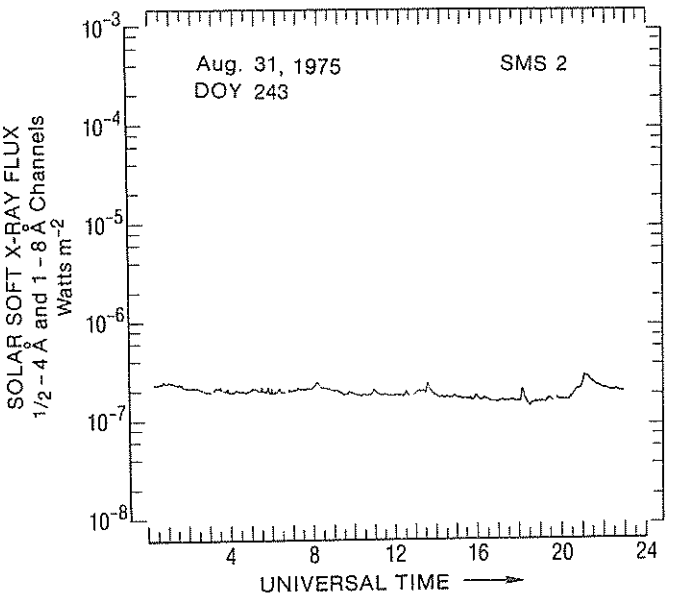


Figure 84. SMS-2 solar X-ray flux for August 31, 1975.

second comparable peak at 1105 UT, a C1 flare at 1331 UT, another C1 at 1458 UT, and finally a C1 spike at 1955 UT.

An examination of SMS-1 data during the above major gaps in SMS-2 data showed the occurrence of the following flares: a double peak C1 flare near 1830 - 1900 UT, August 4; a flurry of C class flares after about 0800 UT on August 5; several M1 flares and numerous C class flares on August 7; minor C flare in the midday gap of August 9; a C3 flare near 0230 UT on August 10, on August 11 SMS-1 suffered an outage similar to that of SMS-2; several microflares midday on August 13, a C3 flare near 1730 UT, an M1 spike flare near 1820 UT, and a C2 flare near 2300 UT on August 22; and low flux plus noise on August 23-25 (<1433 UT).

2.15 September 1975, SMS-2

2.15.1 Solar Activity Overview

The high activity of August died out at the end of August. The X-ray flux in September remained at a moderate level for the first week, and then decreased slowly with an occasional microflare and a C-class flare on September 12. The flux then decreased to very low flux levels from mid September 14 through mid September 17 and then September 21 - 23. SMS-2 data have been recovered for September 24 and the flux was mostly in the range 2 - 3 x 10^{-8} Wm^{-2}. The rapid decreases in flux like those near 1600 UT on September 9, 10, and 11, are most likely not decreases in the solar X-ray flux but may be caused by diurnally recurrent interference from energetic magnetospheric particles.

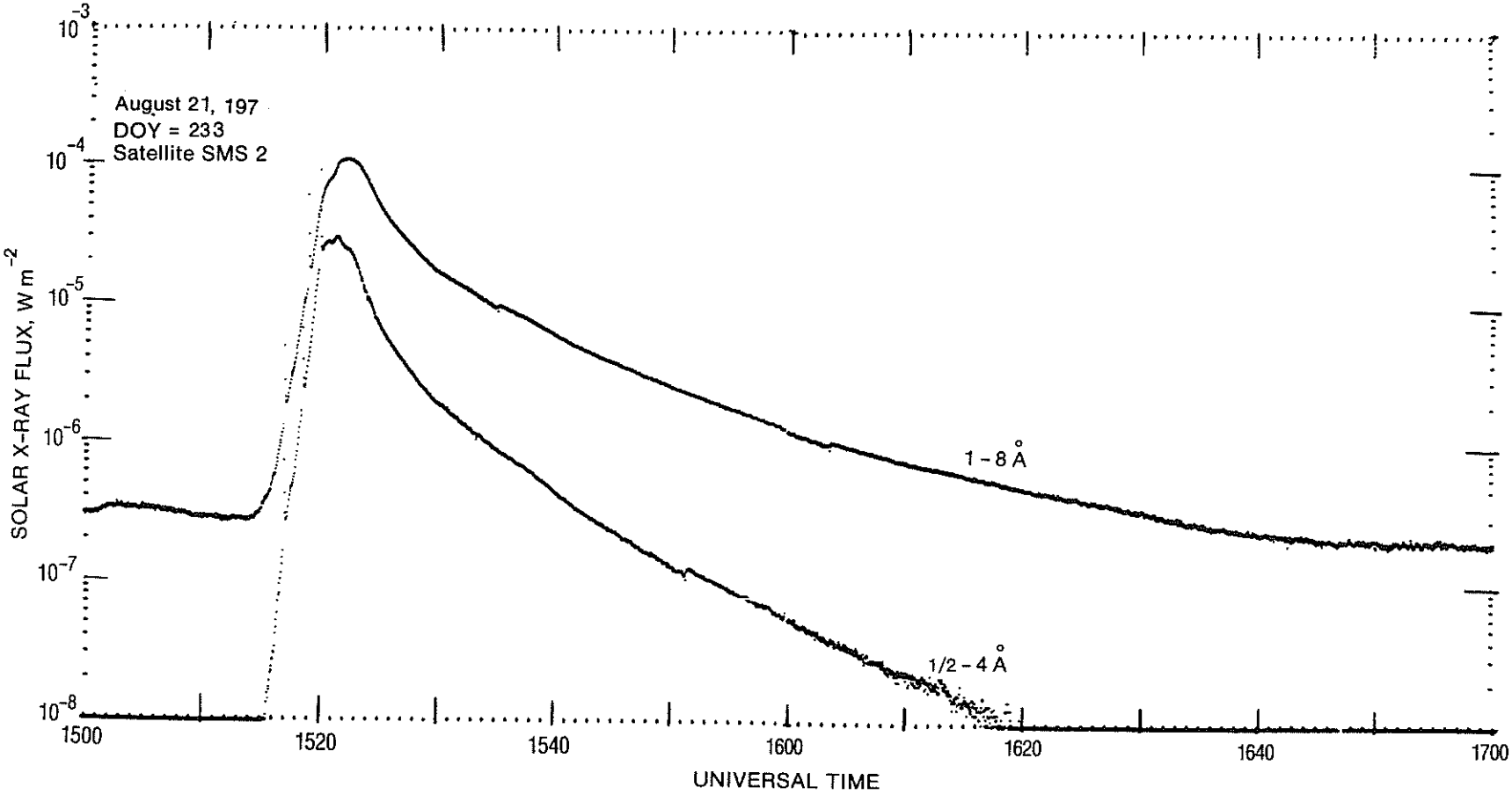


Figure 84a. The X1 solar X-ray burst of 1522 UT, August 21, 1975.

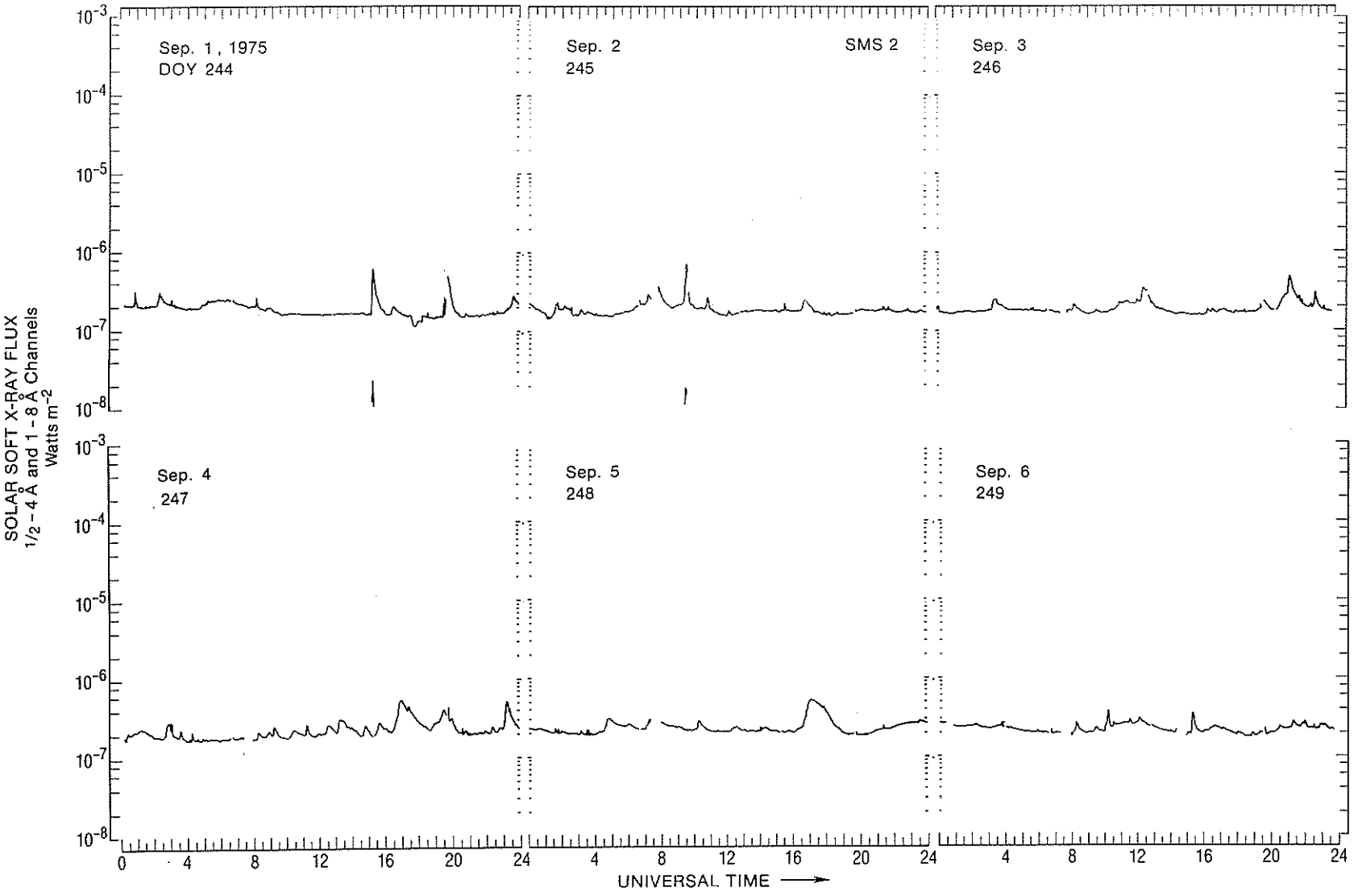


Figure 85. SMS-2 solar X-ray flux for September 1-6, 1975.

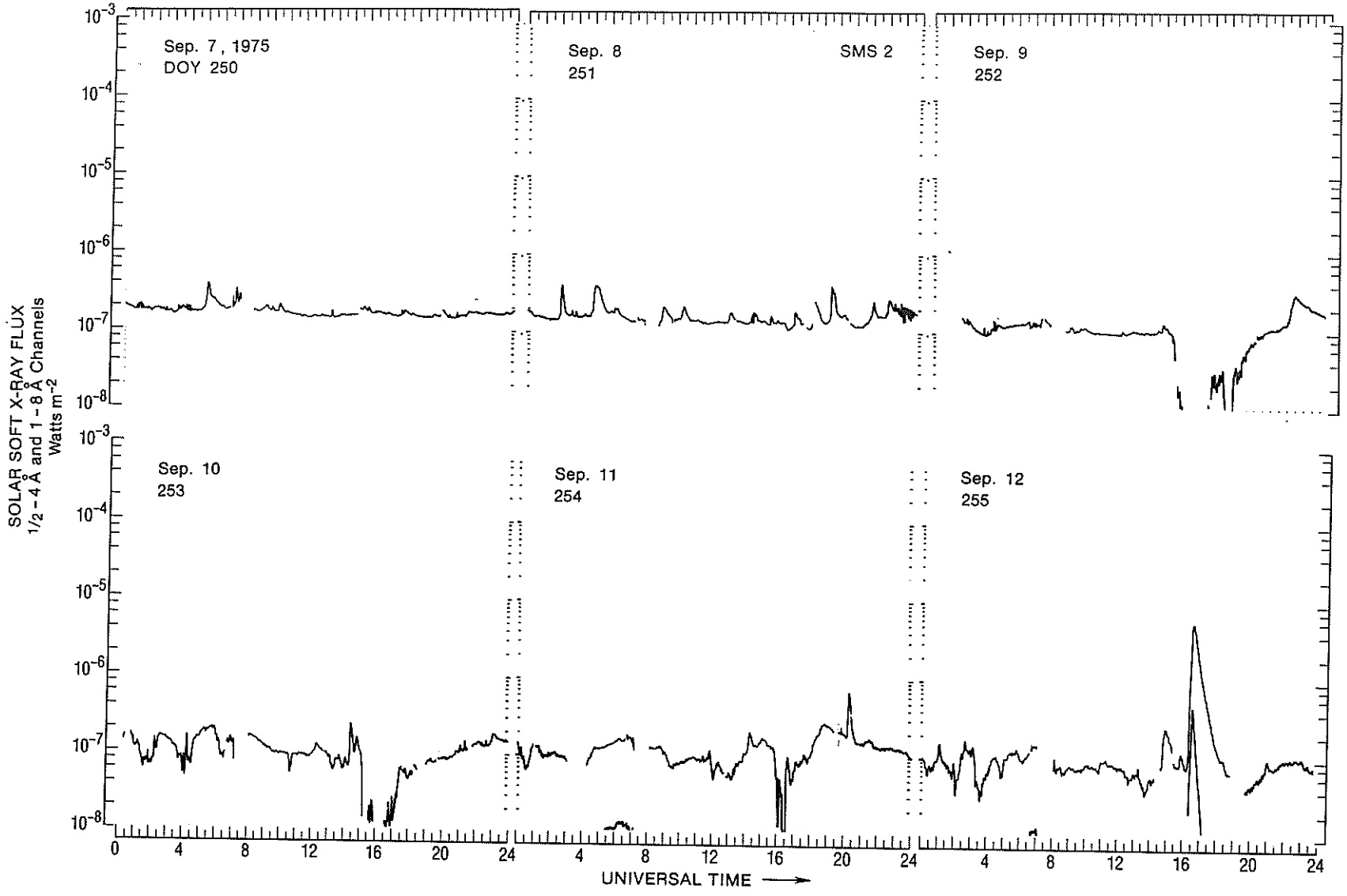


Figure 86. SMS-2 solar X-ray flux for September 7-12, 1975.

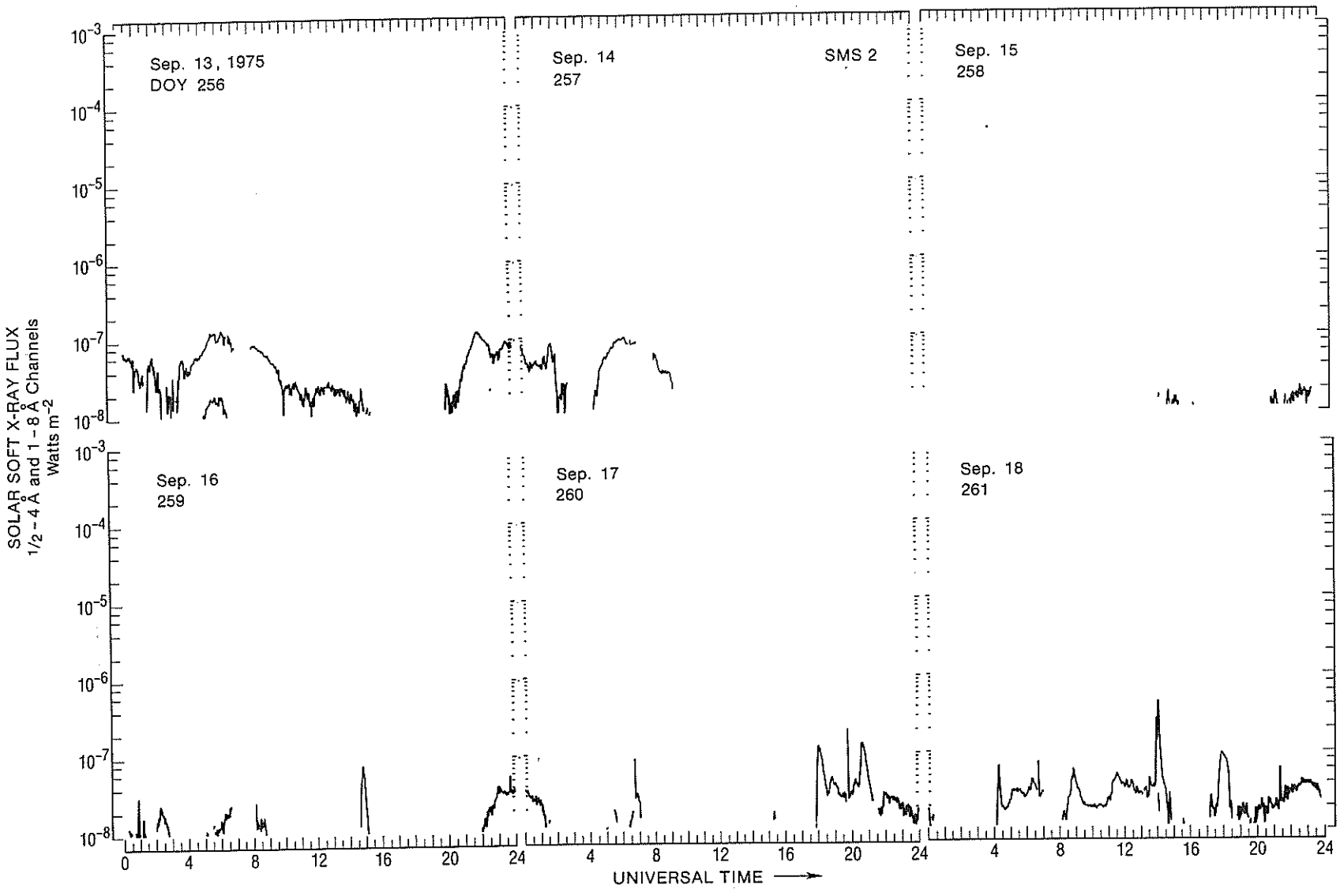
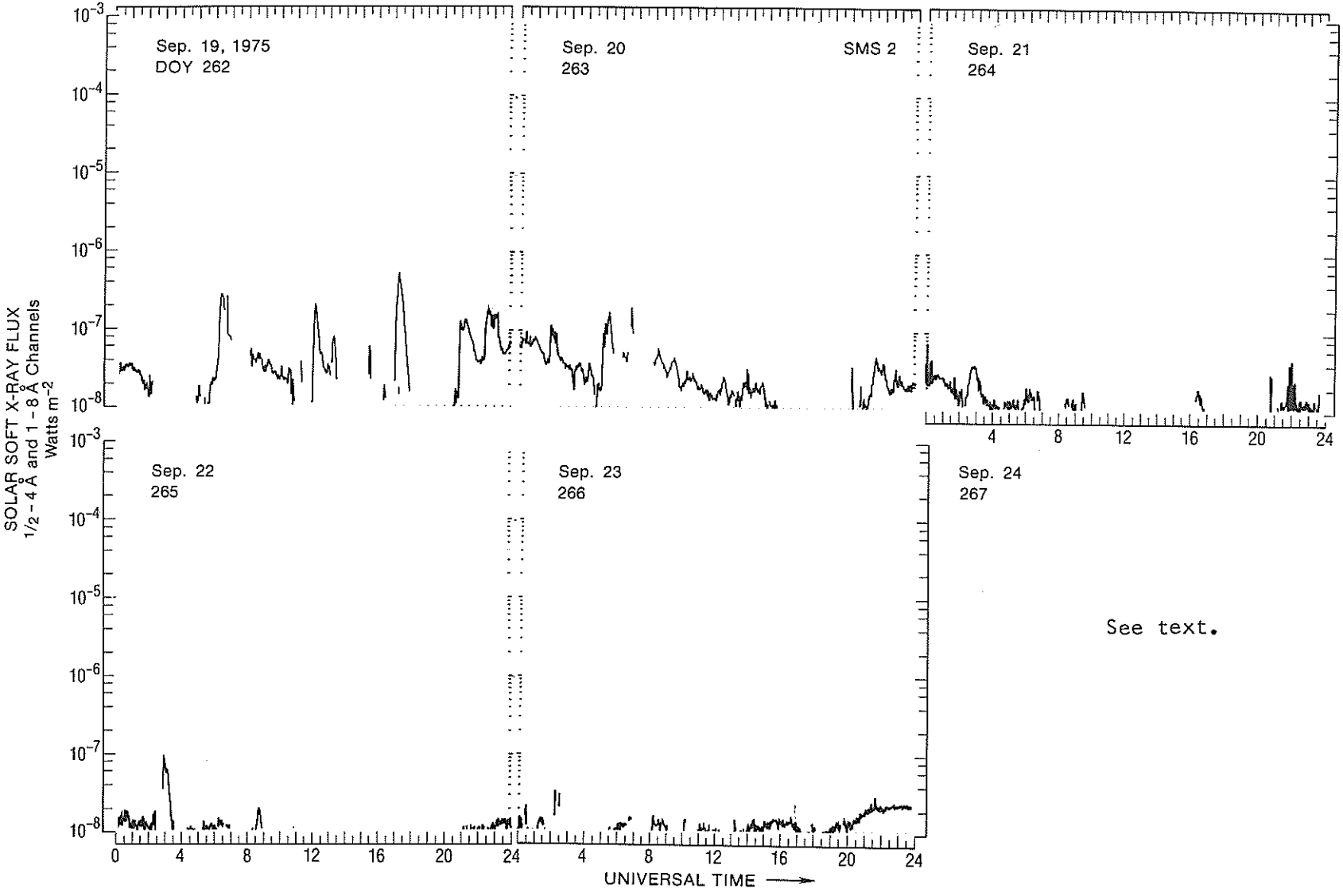


Figure 87. SMS-2 solar X-ray flux for September 13-18, 1975.



See text.

Figure 88. SMS-2 solar X-ray flux for September 19-24, 1975.

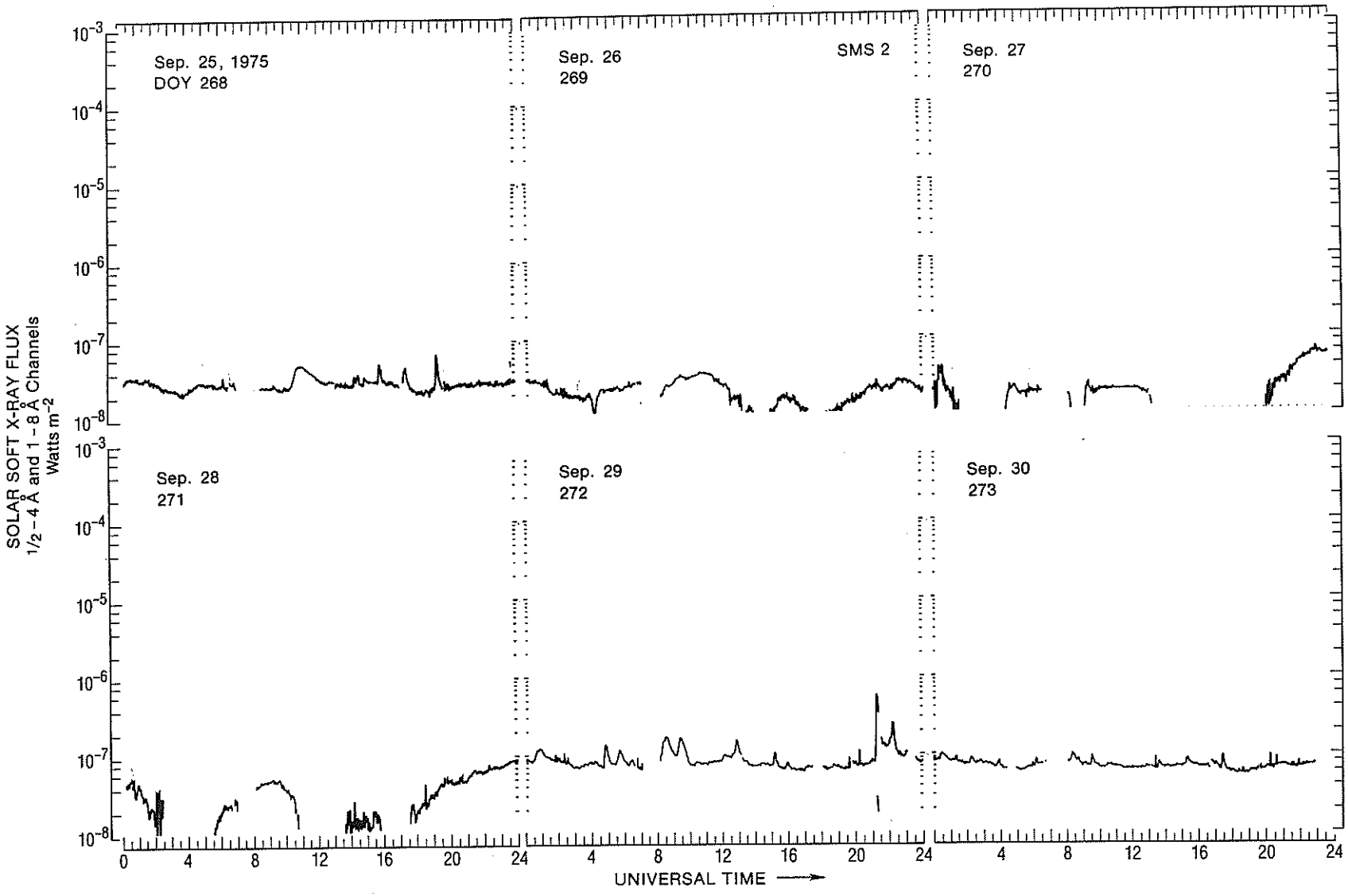


Figure 89. SMS-2 solar X-ray flux for September 25-30, 1975.

2.15.2 Missing Data

SMS-2 missed solar flux measurements for about an hour near 0730 UT after September 3 because the satellite was in the Earth's shadow. The effect of the Earth's shadow starts on September 2 near 0730 UT, as shown in figure 85. Calibrations occurred for about ten minutes near 0640 and 1940 UT daily. Major outages occurred much less frequently in September than in previous months. Most of the time when the curve is not shown in the figure the 1-8Å flux is below 10^{-8} Wm^{-2}. Major data outages occurred during the following periods: 1418 - 1451 UT September 6; 2346 UT September 8 to 0146 UT September 9; 1828 - 1859 UT, September 10; 0300 - 0416 UT, September 11; 1846 - 1944 UT, September 12; 0917 UT September 14 to 1335 UT September 15; 0745 - 1333 UT, September 17; 0217 - 0307 UT, September 18; 0213 - 0452 UT, September 19; 0540 - 0616 UT, September 20; 1641 - 1715 UT, September 24; 1719 - 1757 UT and 2305 - 2334 UT, September 29; 0424 - 0459 UT and 2300 - 2400 UT, September 30. Data have been found for September 24, except for the outage listed above. The 1-8Å X-ray flux on September 24 was generally in the range 2 - 3 x 10^{-8} Wm^{-2}, i.e., at a low flux level with no flares of significance.

2.16 October 1975, SMS-2

2.16.1 Solar Activity Overview

The 1-8Å flux was low during the first week and decreased to very low flux levels during the second week. It increased to low levels during the third week and then decreased to very low flux levels during the last week of October. A few microflares occurred during the first 22 days with the largest flare being a small C1 flare near 0830 UT on October 13.

2.16.2 Missing Data

See figures 90-95. SMS-2 continued to pass through the Earth's shadow for about an hour daily near 0730 UT, tapering off sharply on October 16-18, with no shadow effect on October 19 and thereafter. Most of the time when the X-ray data do not show in the figures, the 1-8A flux was below 10^{-8} Wm^{-2}.

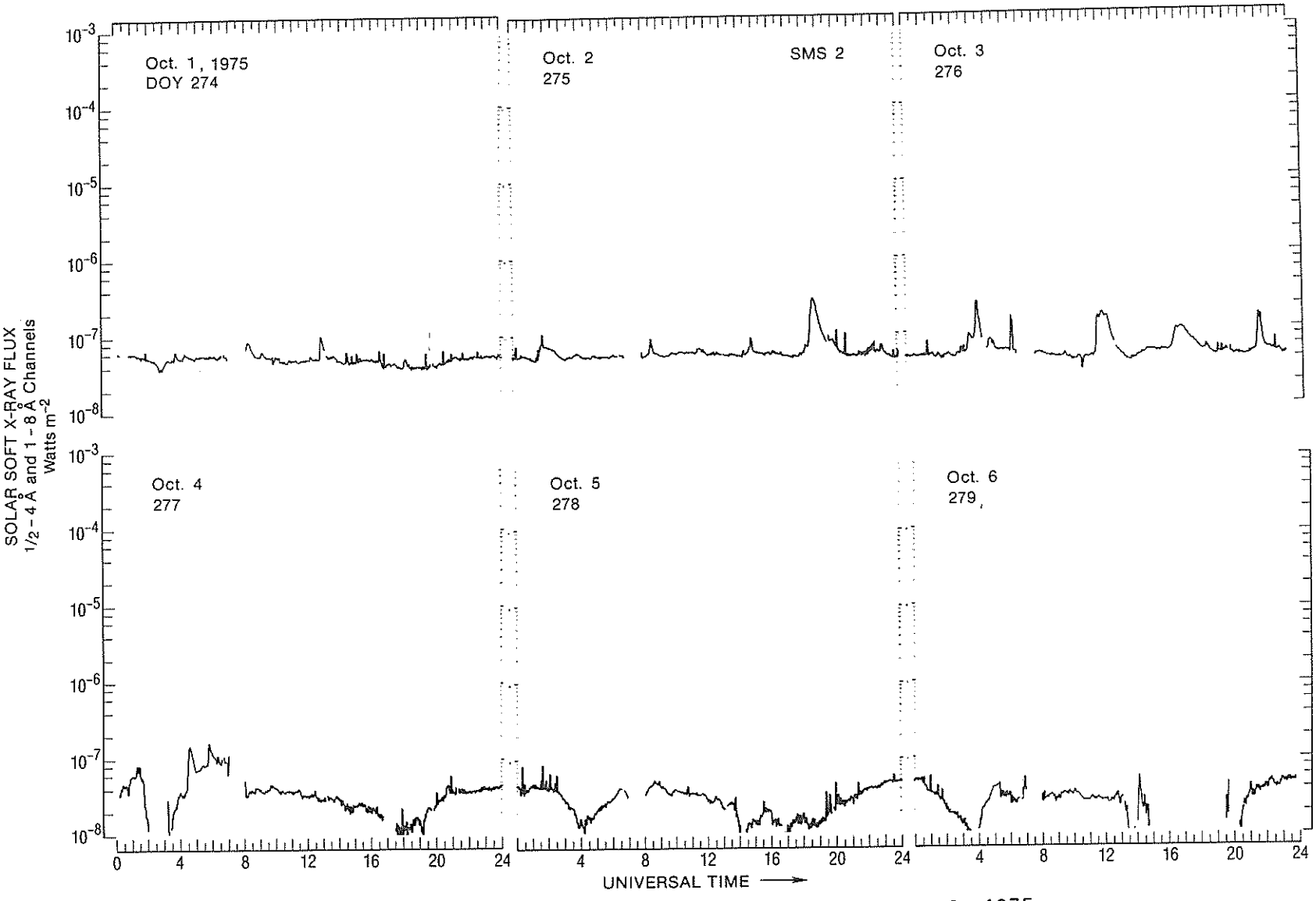


Figure 90. SMS-2 solar X-ray flux for October 1-6, 1975.

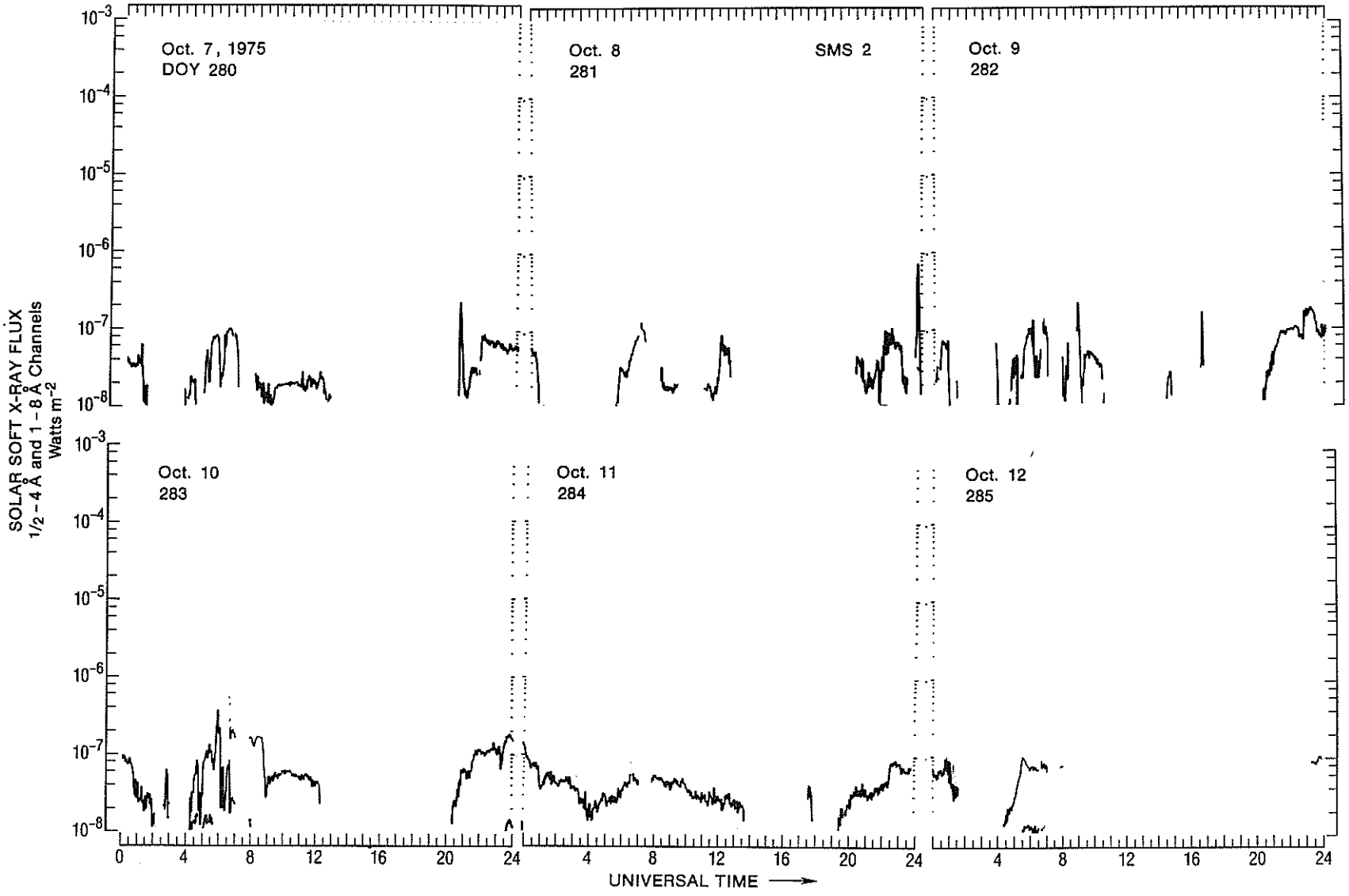


Figure 91. SMS-2 solar X-ray flux for October 7-12, 1975.

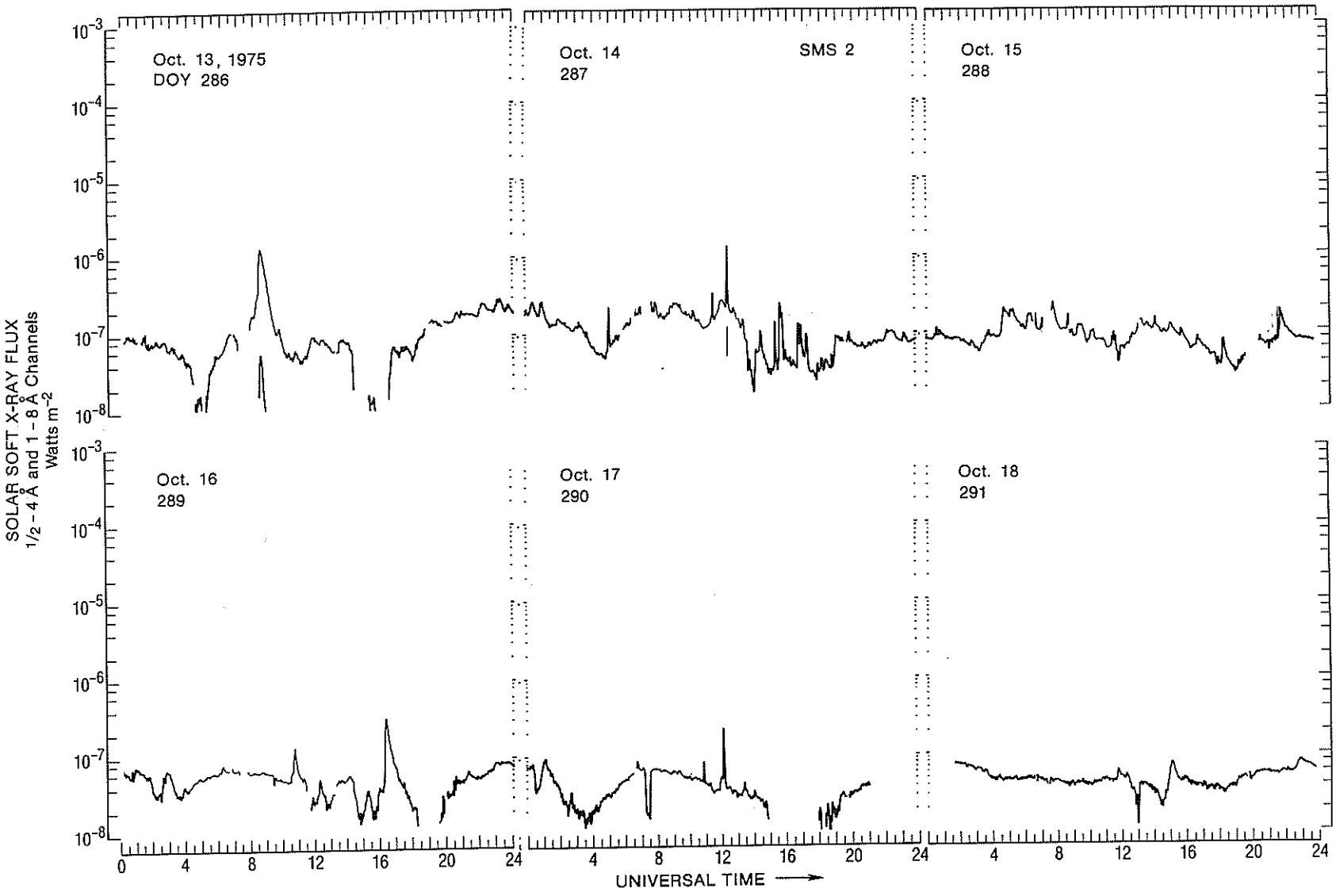


Figure 92. SMS-2 solar X-ray flux for October 13-18, 1975.

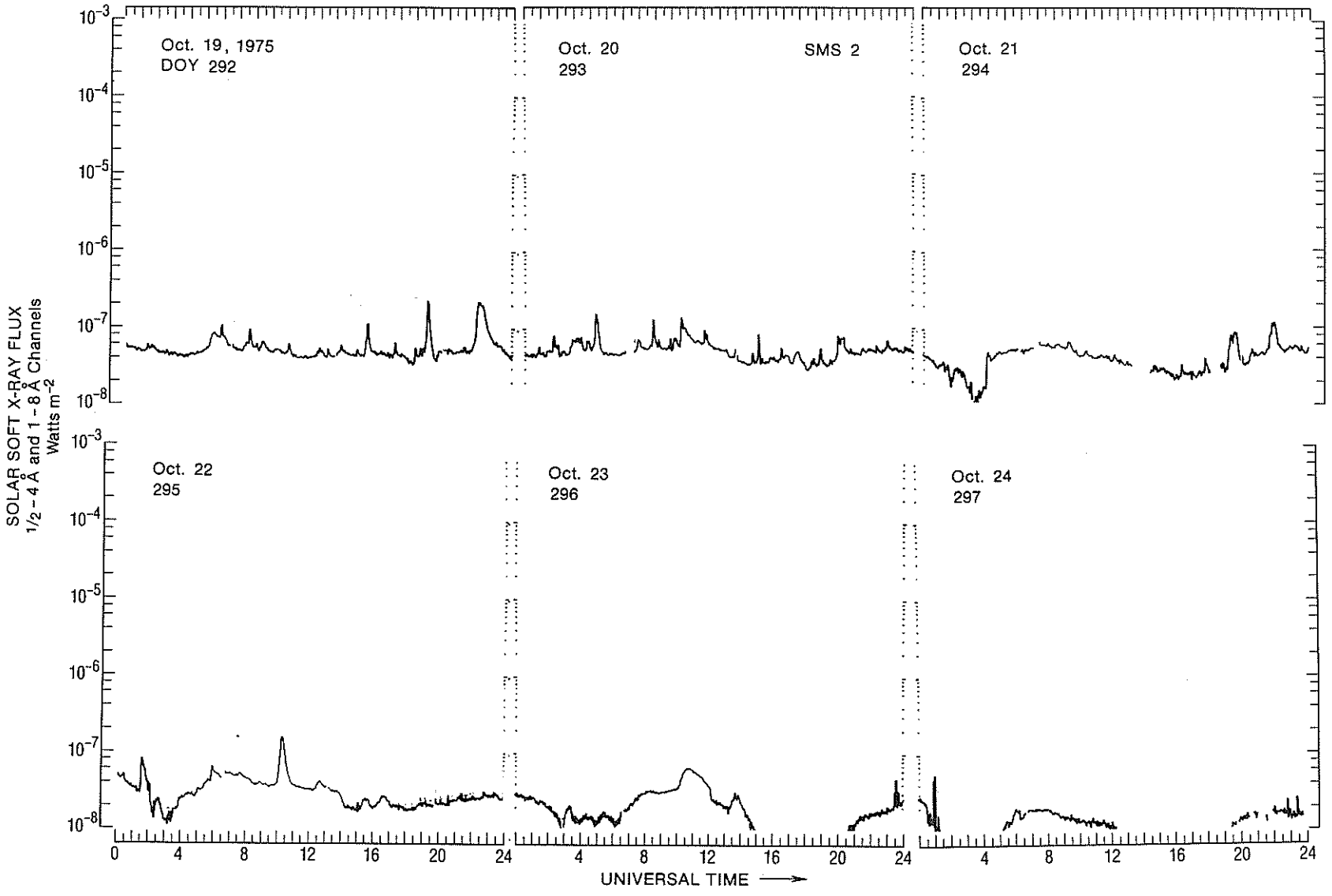
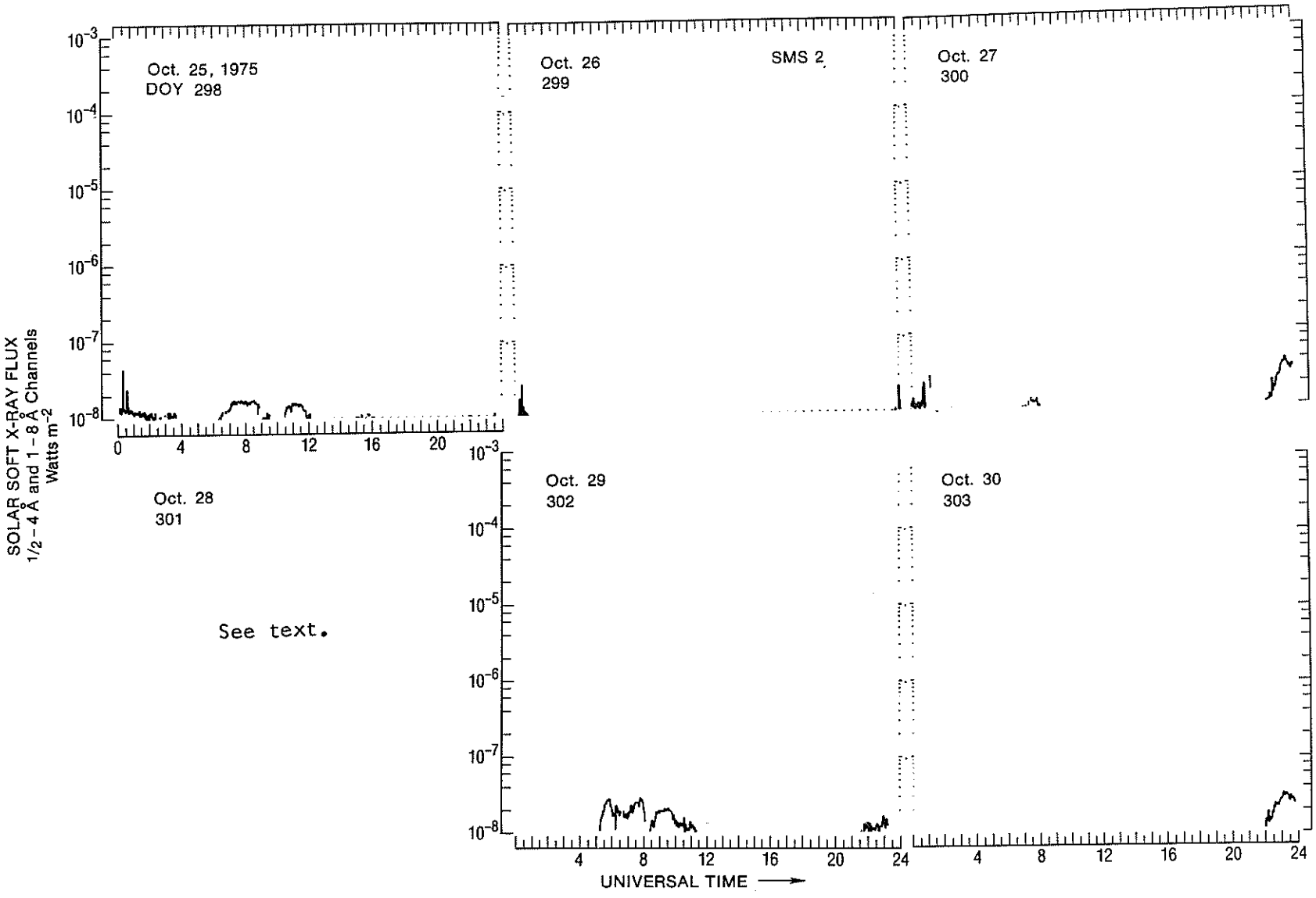


Figure 93. SMS-2 solar X-ray flux for October 19-24, 1975.



See text.

Figure 94. SMS-2 solar X-ray flux for October 25-30, 1975.

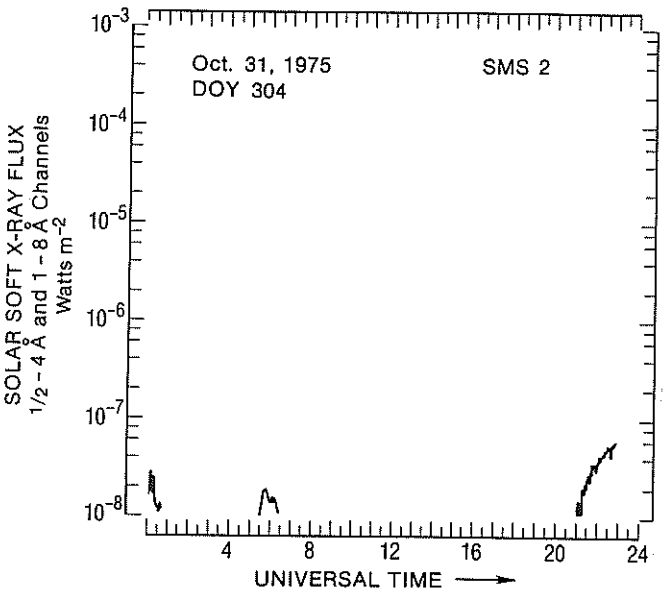


Figure 95. SMS-2 solar X-ray flux for October 31, 1975.

Calibrations were at 0640 and 1940 UT daily. Major outages occurred during the following periods: 0016 - 0047 UT, October 1; 1635 - 1720 UT, October 4; 0858 - 1033 UT, October 8; 0137 - 0218 UT, 0704 - 0751 UT, 0802 - 1724 UT and 1940 - 2150 UT, October 12; 2101 UT October 17 to 0141 UT October 18; 1251 - 1400 UT and 1741 - 1820 UT, October 21; 2055 - 2152 UT, October 24; 0712 - 1415 UT and 1945 - 2025 UT, October 28; and 2300 - 2400 UT, October 31. SMS-2 data have been found for October 28 except for the outages listed above. The 1-8Å flux was $\leq 10^{-8}$ Wm^{-2} all day, i.e., very low.

2.17 November 1975, SMS-2

2.17.1 Solar Activity Overview

The solar X-ray flux rose from the very low levels of September and October to moderate levels in November. See figures 96-100. Note the flurry of small flares during November 4-6, with four flares $\geq$ C1 on November 5 and again on November 6. Another flurry of flares are shown in figure 98 ending with an M2 flare on November 21. After that the flux decreased to very low levels on November 28.

2.17.2 Missing Data

Calibrations occurred daily near 0640 and 1940 UT. Major outages occurred during the following periods: 1015 - 1537 UT, November 4; 1302 - 1416 UT, November 7; 0753 - 0918 UT, 1148 - 1427 UT, 2056 - 2146 UT, November 9; 1105 - 1351 UT and about 1840 - 2000 UT, November 10; 2139 - 2239 UT,

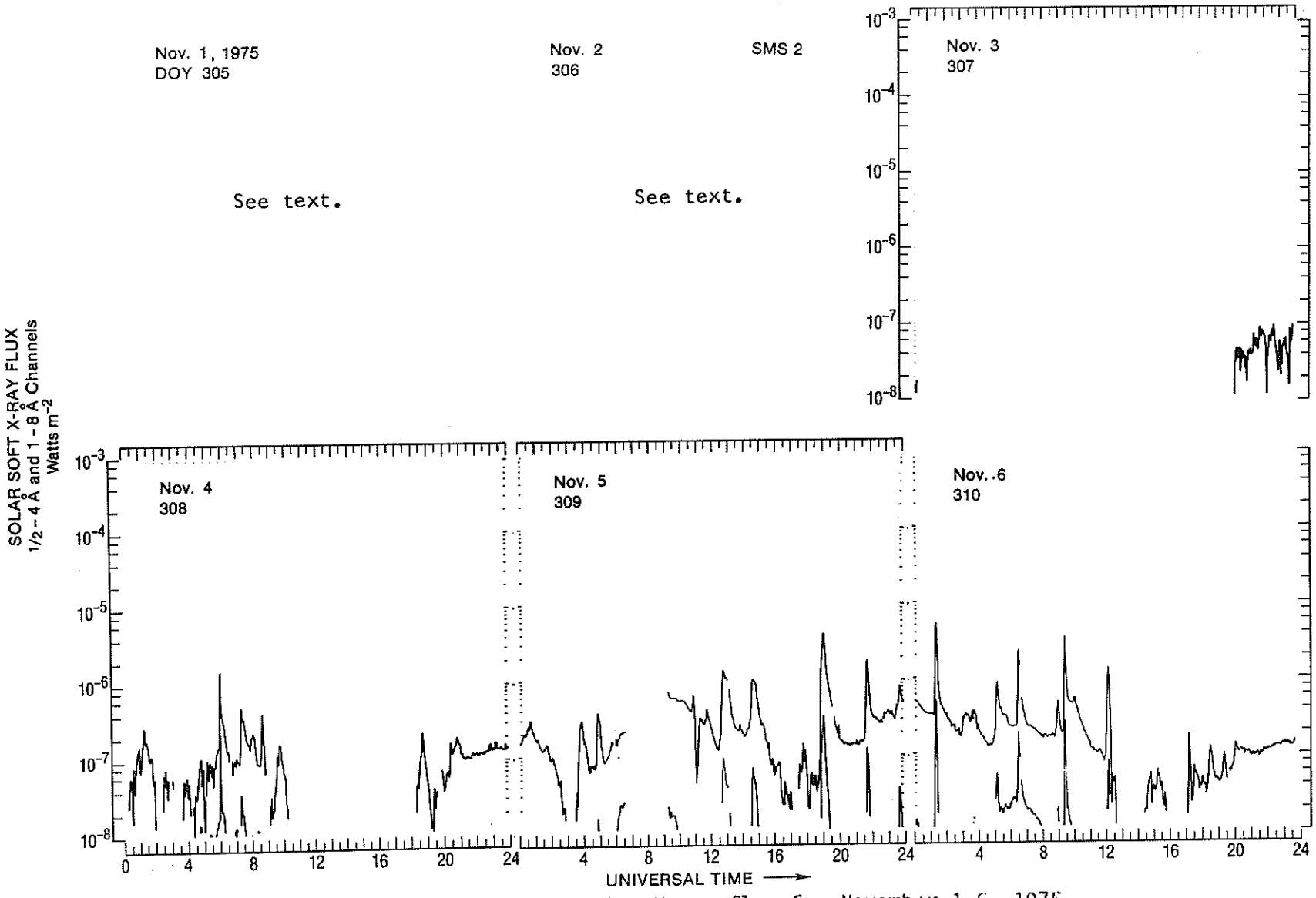


Figure 96. SMS-2 solar X-ray flux for November 1-6, 1975.

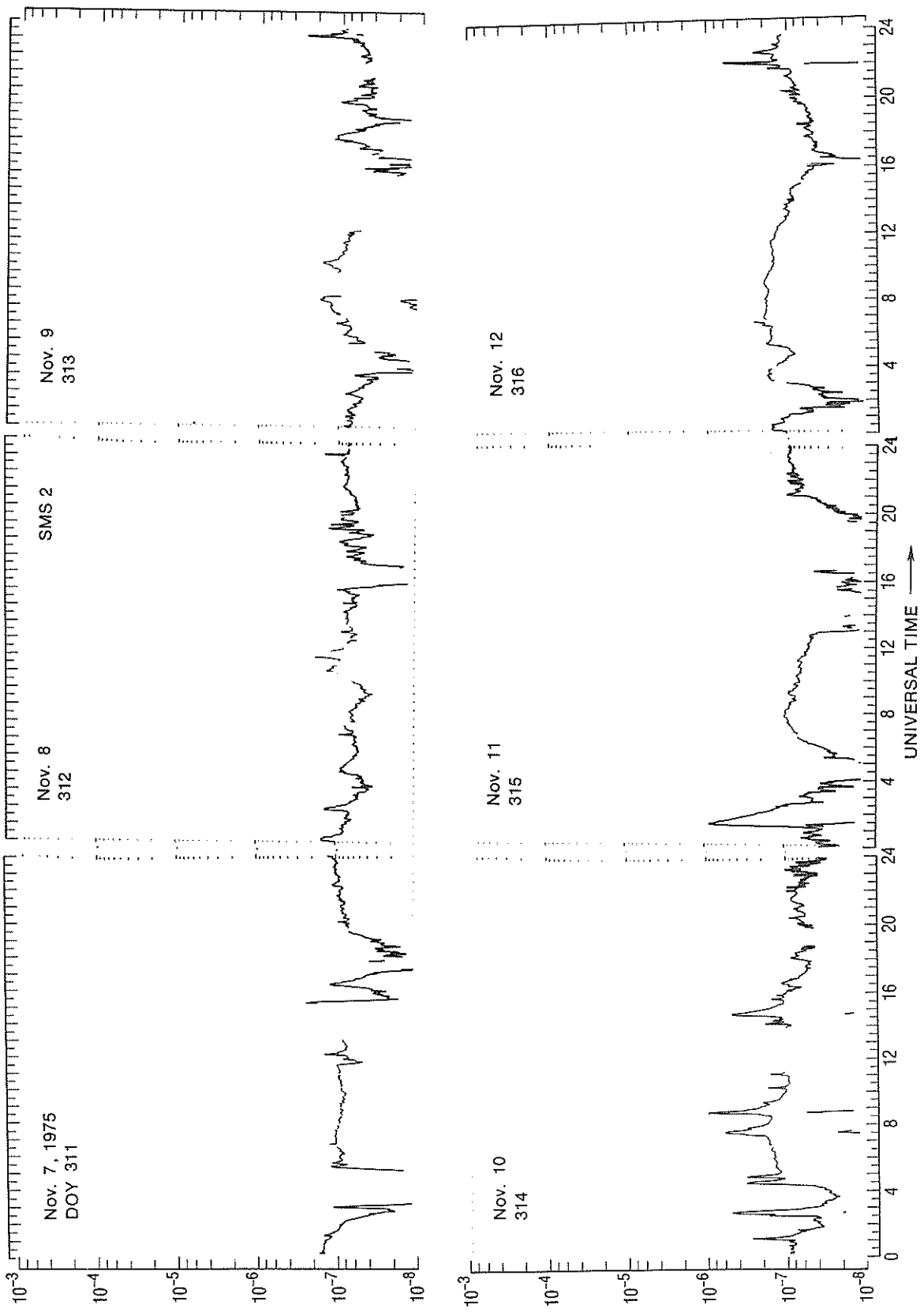


Figure 97. SMS-2 solar X-ray flux for November 7-12, 1975.

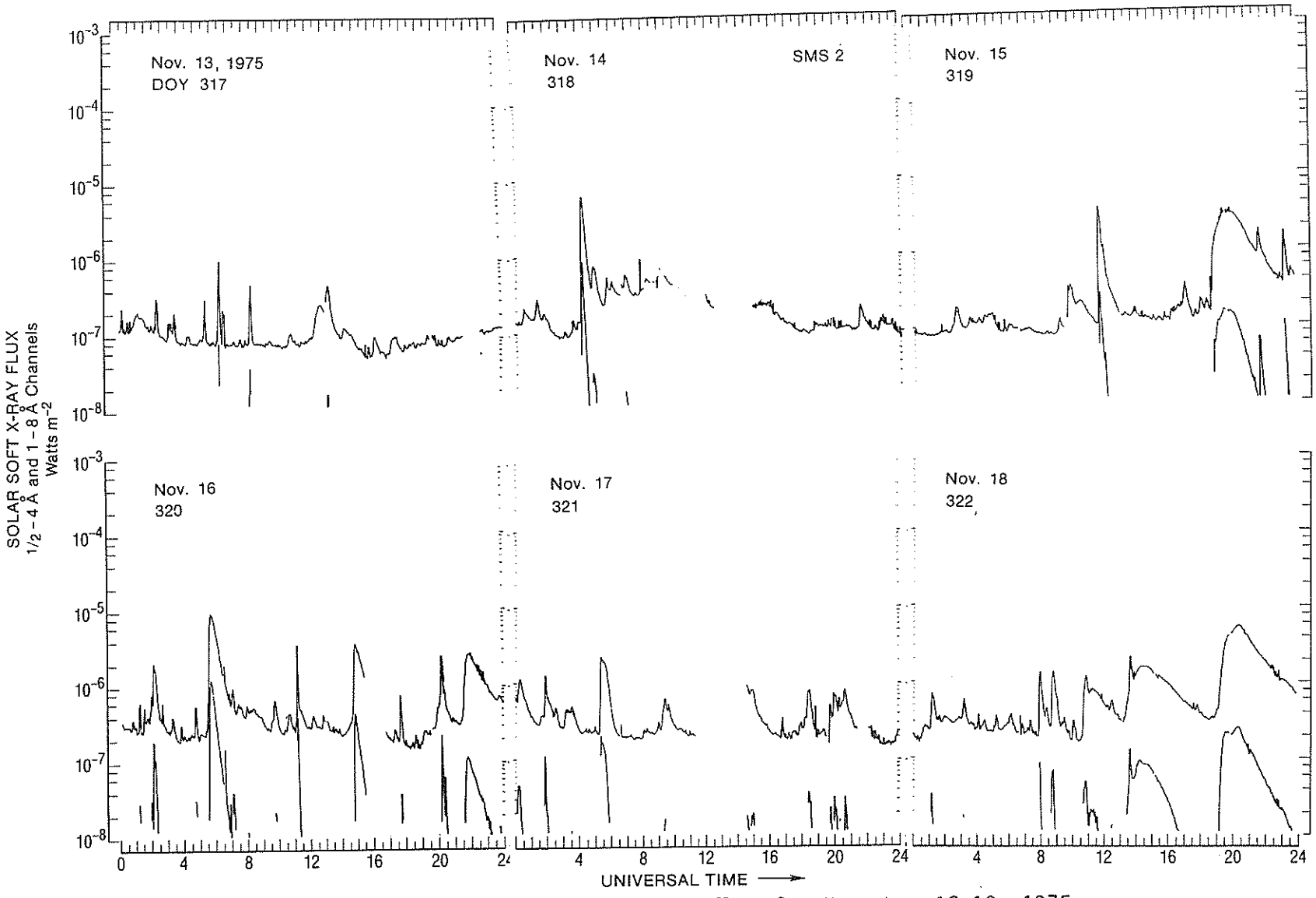


Figure 98. SMS-2 solar X-ray flux for November 13-18, 1975.

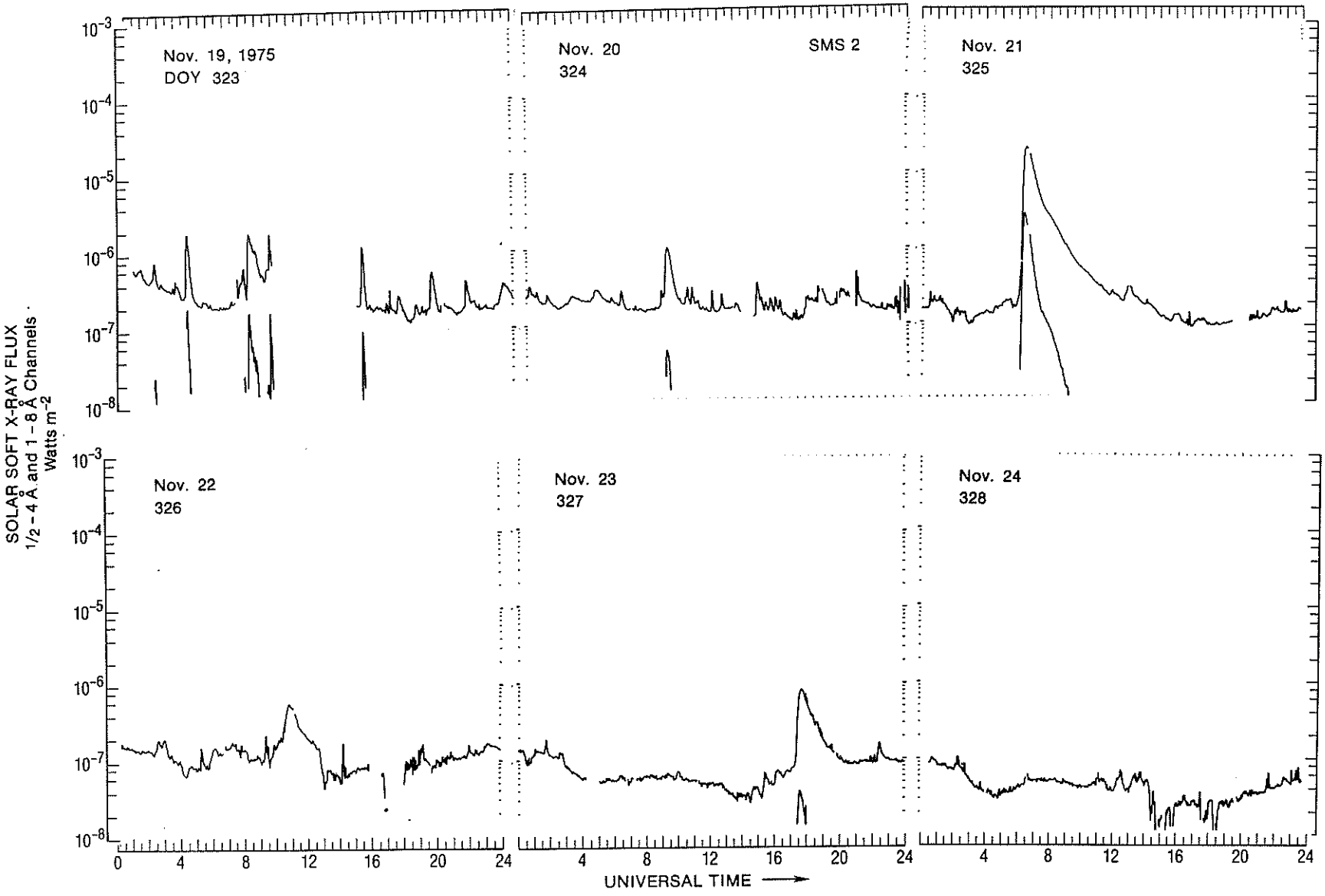


Figure 99. SMS-2 solar X-ray flux for November 19-24, 1975.

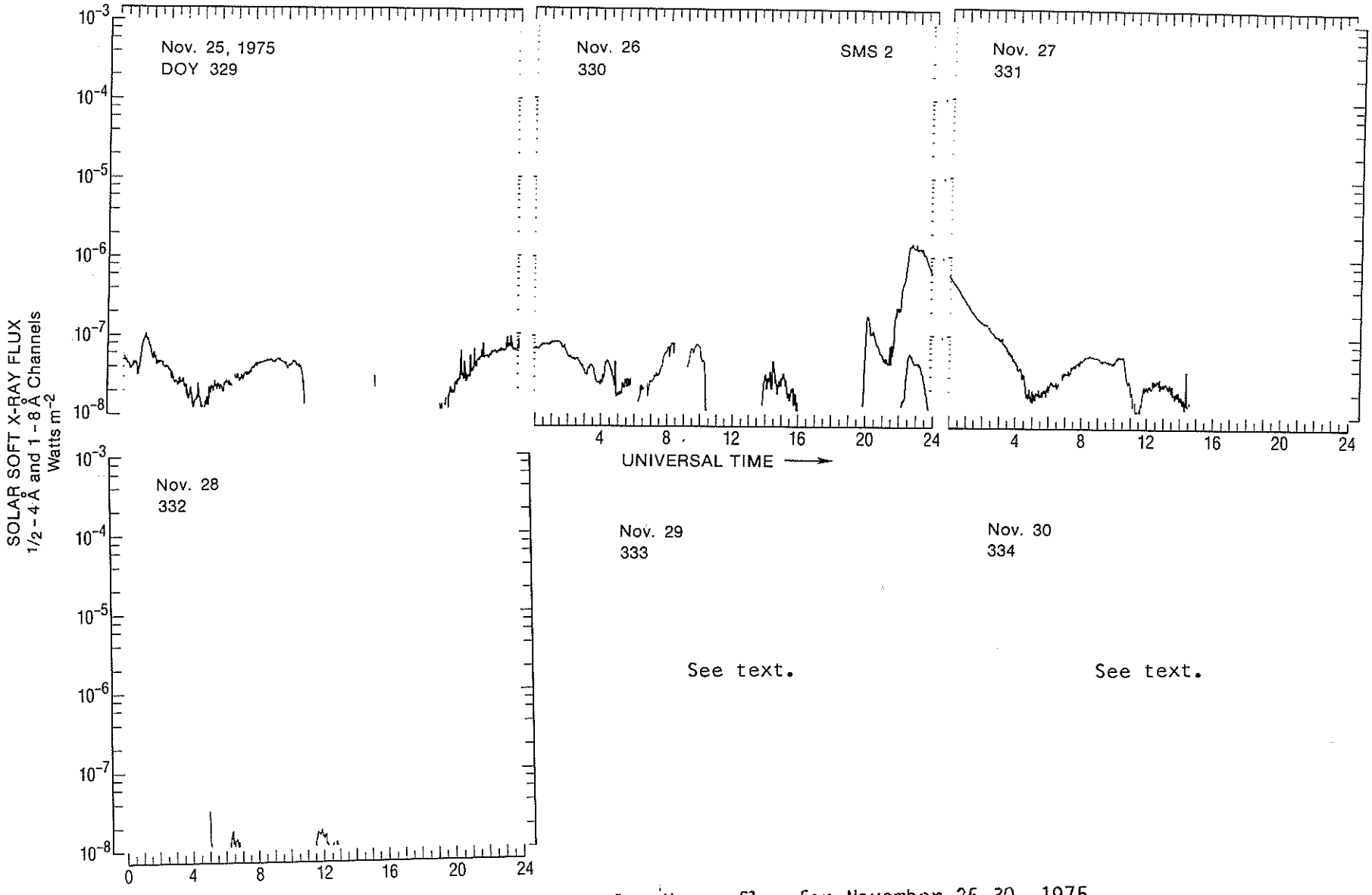


Figure 100. SMS-2 solar X-ray flux for November 25-30, 1975.

November 13; 0951 - 1159 UT and 1226 - 1450 UT, November 14; 1531 - 1649 UT, November 16; 1123 - 1435 UT and 2128 - 2208 UT, November 17; 0856 - 1412 UT, November 19; 1331 - 1419 UT, November 20; 1544 - 1634 UT, November 22; 0408 - 0456 UT, November 23; 1456 - 1646 UT, November 25; 0823 - 0910 UT, November 26; 1427 UT November 27 to 0232 UT November 28 and 2300 - 2400 UT, November 30. Data have been found for November 1, 2, early portion of the 3rd, during the gap on November 5 in figure 96, on the 29th, and 30th. The 1-8A X-ray flux was very low at $\lesssim 10^{-8}$ Wm^{-2} most of the time during all of these days with the following exceptions: (1) the 1-8A flux slowly decreased from about 8 to 1 x 10^{-8} Wm^{-2} from about 0000 to 0400 UT on November 1; (2) a slow rise (~ 2 hours) and fall with a peak of about $2\frac{1}{2}$ x 10^{-8} Wm^{-2} near 0900 UT, November 1; (3) another slow rise and decay with a peak of about 4 x 10^{-8} Wm^{-2} near 0300 UT, November 1; (4) a slow rise and decay with a low peak of about 3 x 10^{-8} Wm^{-2} near 0700 UT, November 2; (5) small events (~10^{-8} Wm^{-2}) near 0245 UT, November 3; (6) slightly larger events (~10^{-7} Wm^{-2}) near 0435 UT, November 3; (7) a 1-8A flux of about 2 x 10^{-7} Wm^{-2} after 0700 UT rising in a C1 flare at 0900 UT on November 5; (8) a rise from $\leq 10^{-8}$ Wm^{-2} to about 2 x 10^{-8} from 2200 to 2400 UT on November 29, followed by a slow decay to below 10^{-8} at about 0100 UT, November 30; (9) an increase to 4 x 10^{-8} from 0700 - 0800 UT with the 1-8A flux then ranging from 1 - 6 x 10^{-8} Wm^{-2} from 0800 - 0900 UT, November 30; and finally (10) a slow increase to 2 x 10^{-8} Wm^{-2} from 2200 - 2300 UT, November 30.

2.18 December 1975, SMS-2

2.18.1 Solar Activity Overview

See figures 101-106. The X-ray flux decreased from low flux levels during the first eleven days to very low levels for the rest of December. A moderately active period for small flares occurred during December 4-11.

2.18.2 Missing Data

Calibrations continued to be at about 0640 and 1940 UT daily. Most of the time when the data trace does not show in the figures, it is because the measured flux was below 10^{-8} Wm^{-2}. Major outages occurred during the

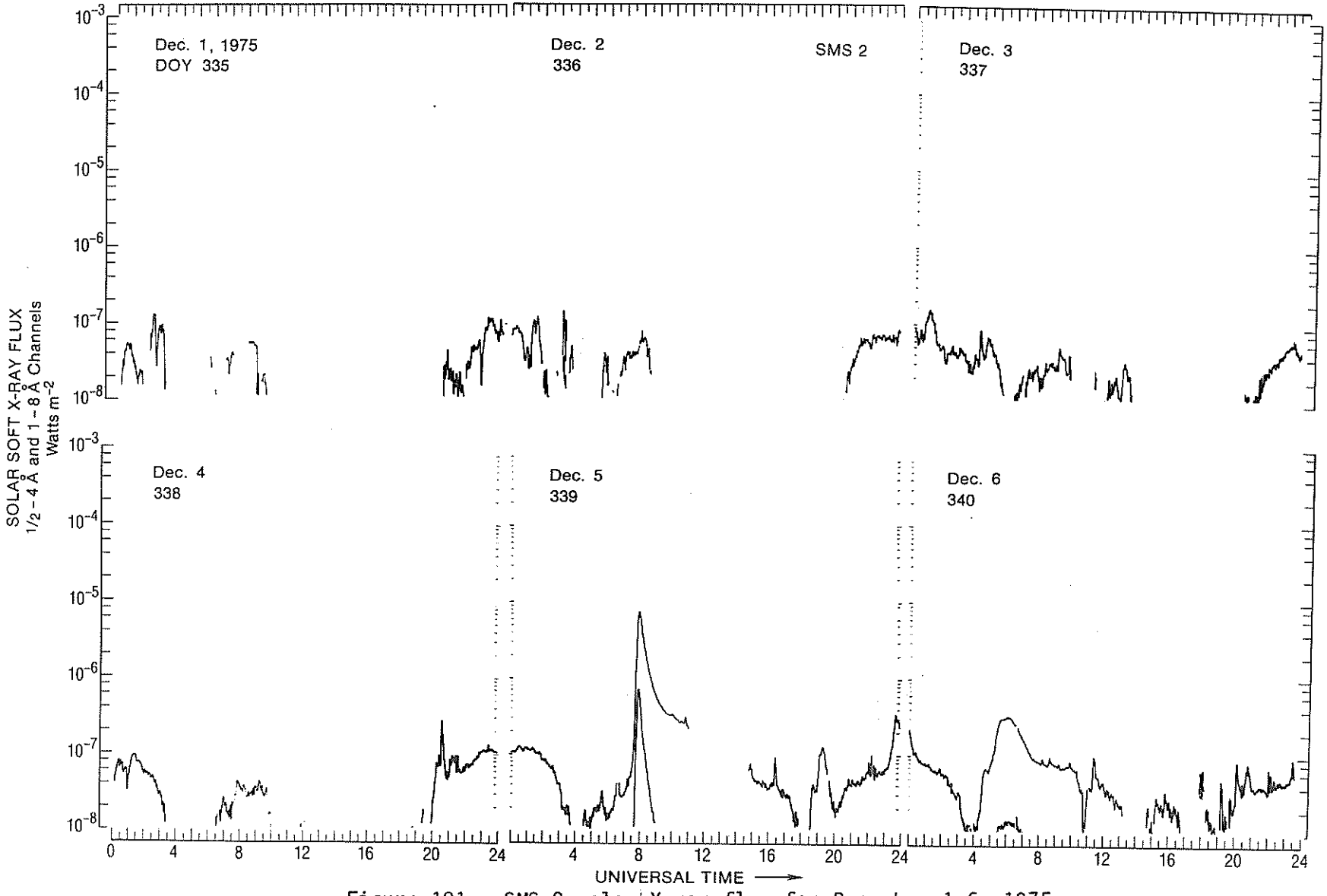


Figure 101. SMS-2 solar X-ray flux for December 1-6, 1975.

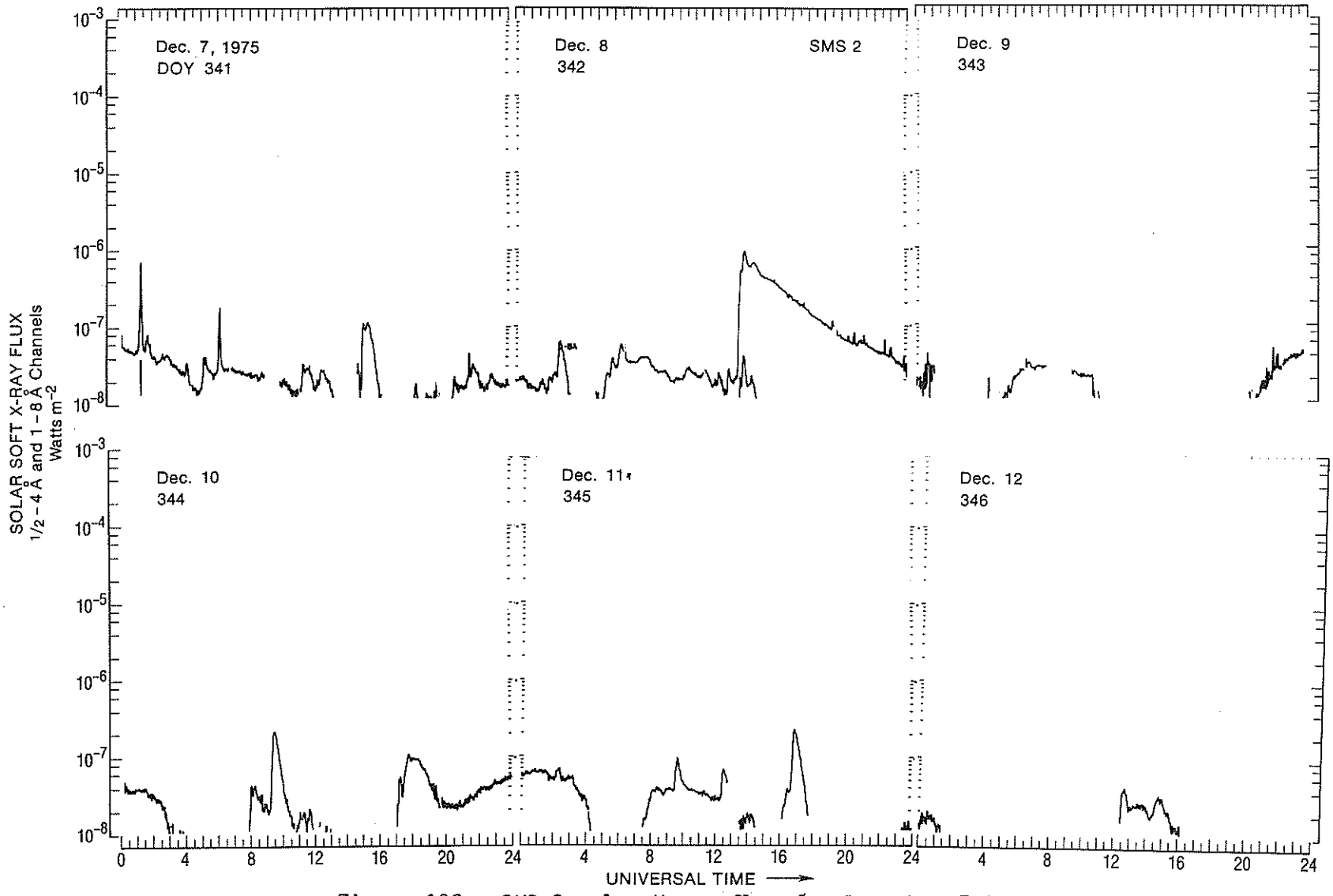


Figure 102. SMS-2 solar X-ray flux for December 7-12, 1975.

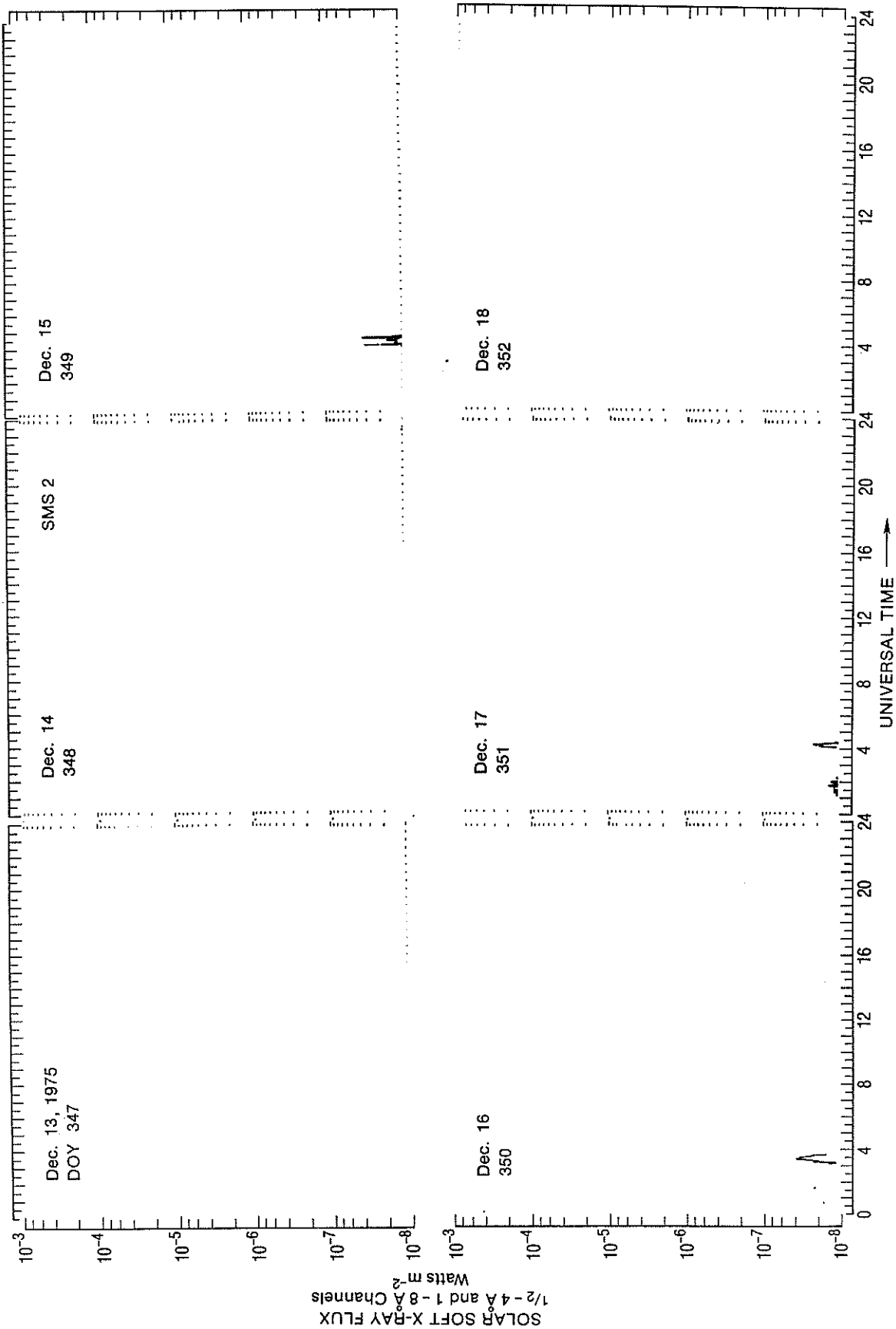


Figure 103. SMS-2 solar X-ray flux for December 13-18, 1975.

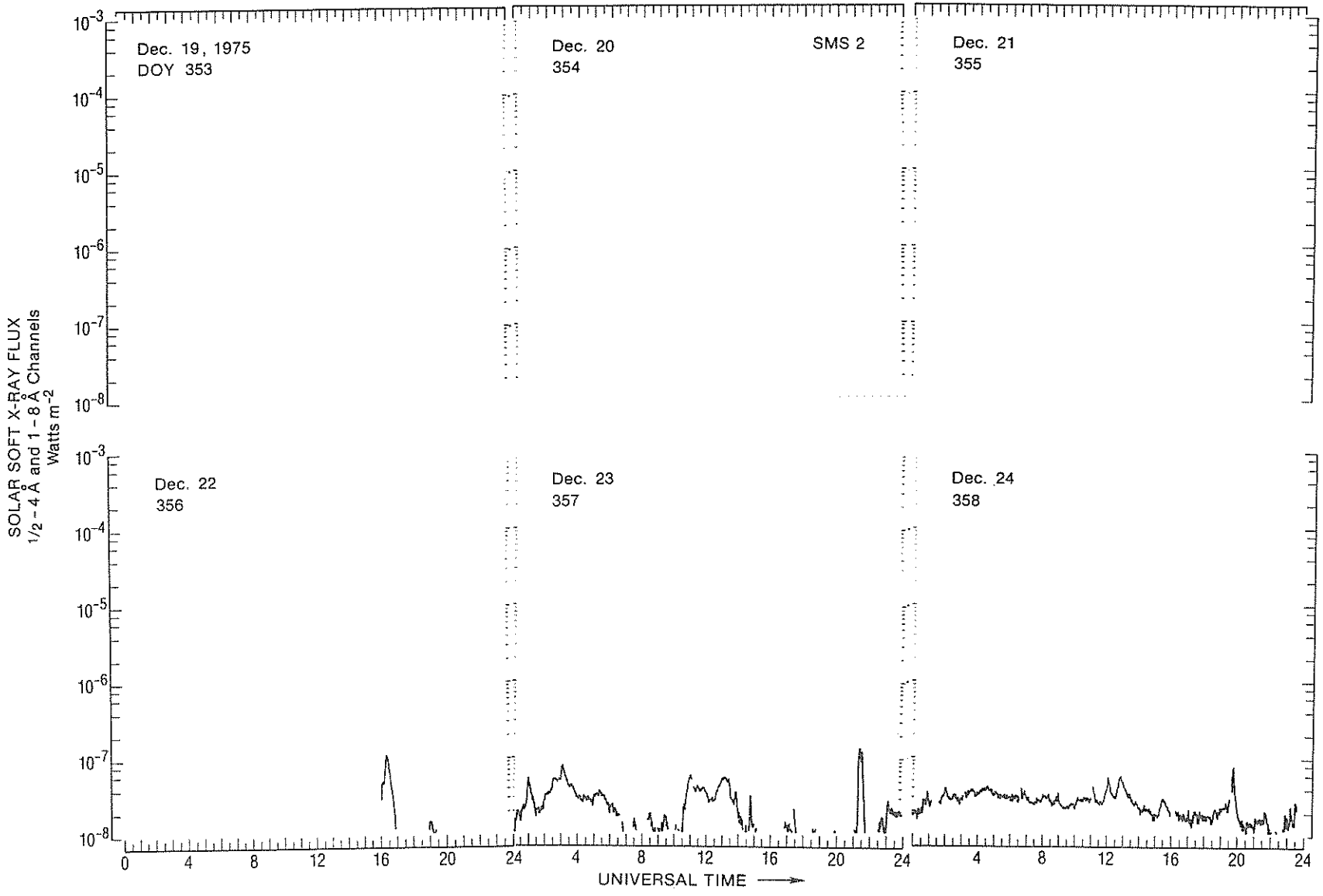


Figure 104. SMS-2 solar X-ray flux for December 19-24, 1975.

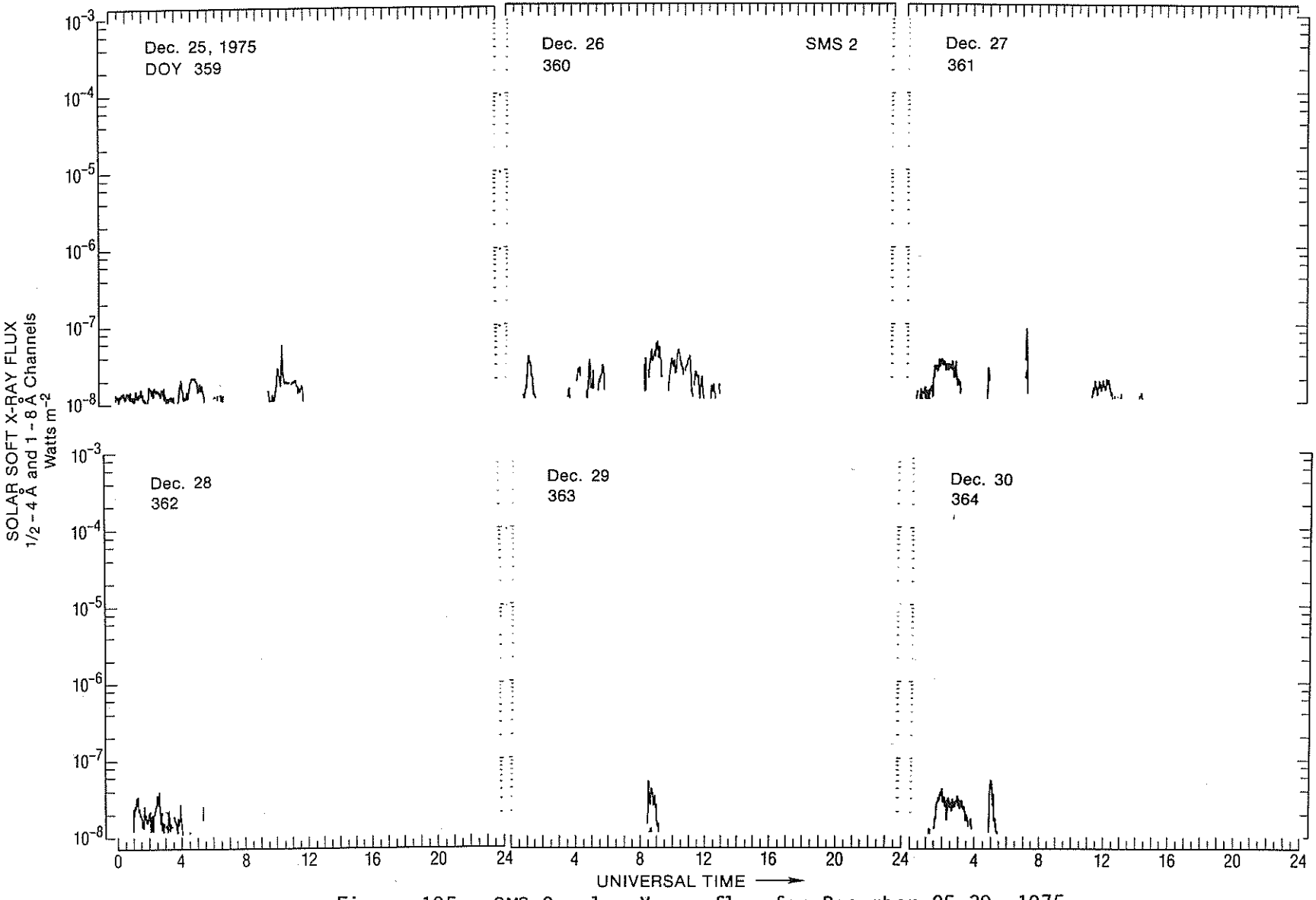


Figure 105. SMS-2 solar X-ray flux for December 25-30, 1975.

following periods: 0710 - 0807 UT, December 1; 0956 - 1036 UT, December 3; 1101 - 1443 UT, December 5; 0856 - 0953 UT, December 7; 0856 - 0934 UT, December 9; 1302 - 1351 UT and 1539 - 1653 UT, December 10; 1241 - 1325 UT, December 11; 1645 - 1813 UT, December 13; 0847 - 1032 UT, December 15; 1024 - 1440 UT, December 17; 2109 - 2218 UT, December 20; 1645 - 1720 UT, December 21; 0109 - 0138 UT, December 24; and 0656 - 0942 UT and 1645 - 1812 UT, December 25.

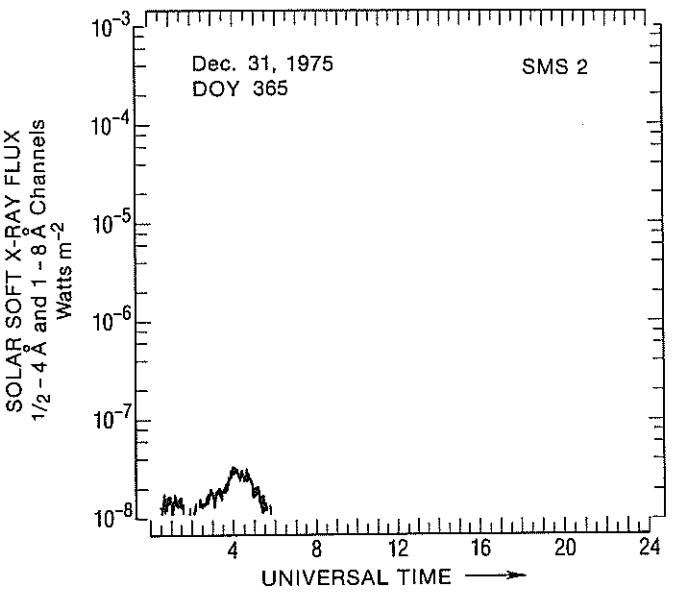


Figure 106. SMS-2 solar X-ray flux for December 31, 1975.

2.19 January 1976, SMS-2

2.19.1 Solar Activity Overview

See figures 107-112. The solar X-ray flux was very low for the first ten days and then rose to moderate levels during January 12-14, when a flurry of C-class flares occurred and an M1 flare at 0630 UT, January 12. Then the X-ray flux and the magnitude and rate of flares declined slowly from January 15 to very low flux levels on January 21. The X-ray flux was very low most of the time for the rest of January.

2.19.2 Missing Data

Calibrations were carried out for about ten minutes near 0640 and 1940 UT, daily, through January 19. On January 19 and thereafter, the calibrations were near 1040 and 2140 UT. Previous months had a systematic daily

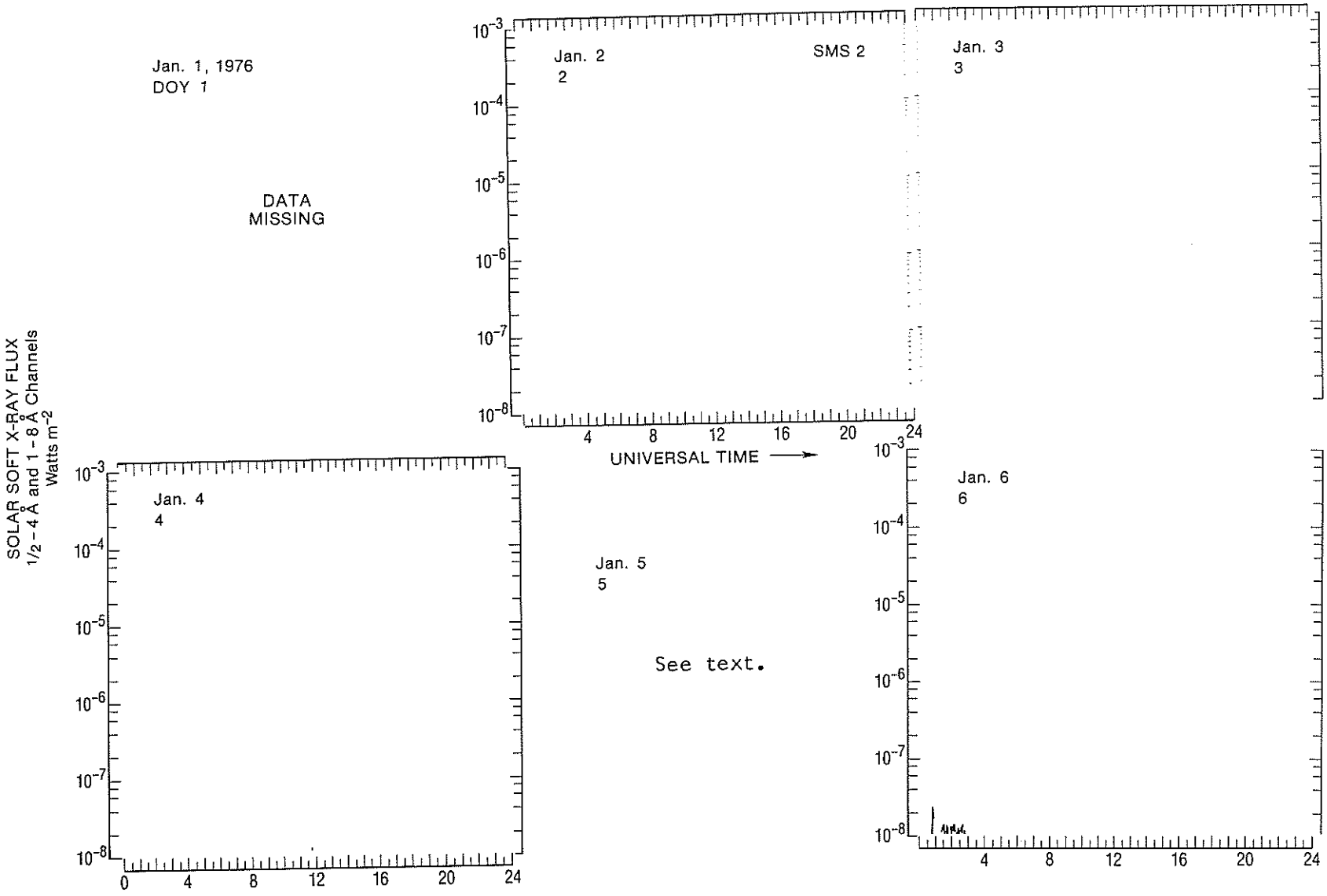


Figure 107. SMS-2 solar X-ray flux for January 1-6, 1976.

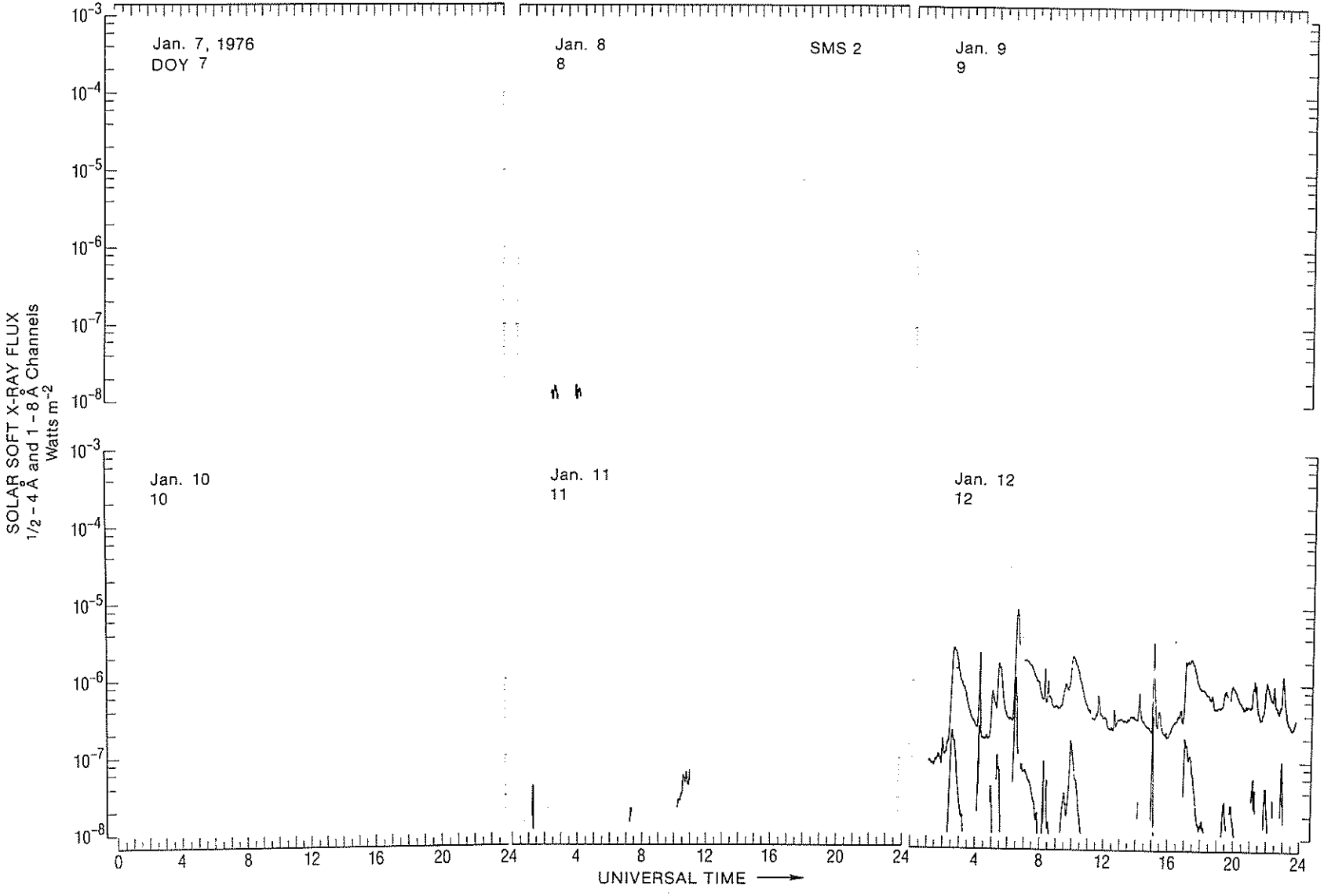


Figure 108. SMS-2 solar X-ray flux for January 7-12, 1976.

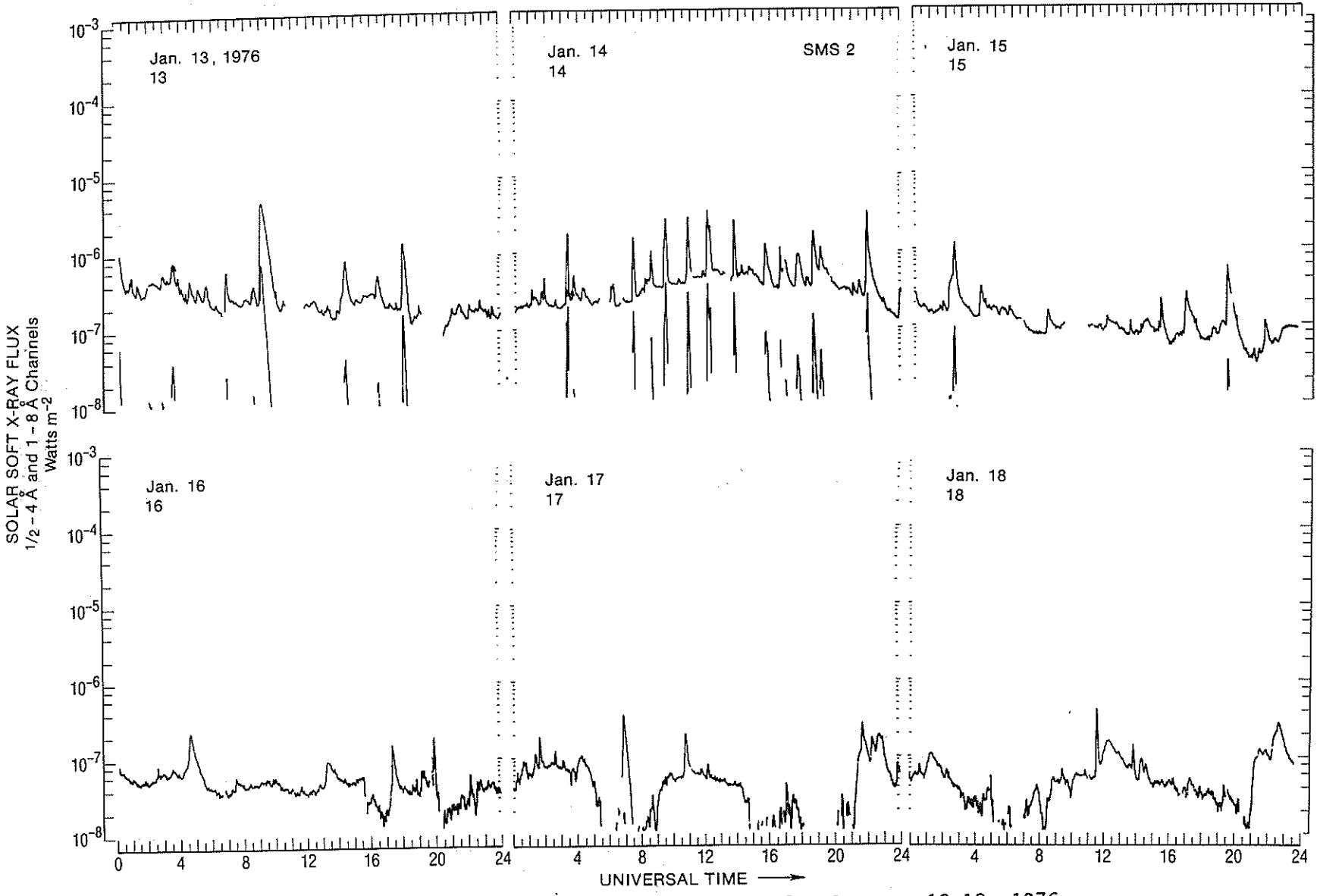


Figure 109. SMS-2 solar X-ray flux for January 13-18, 1976.

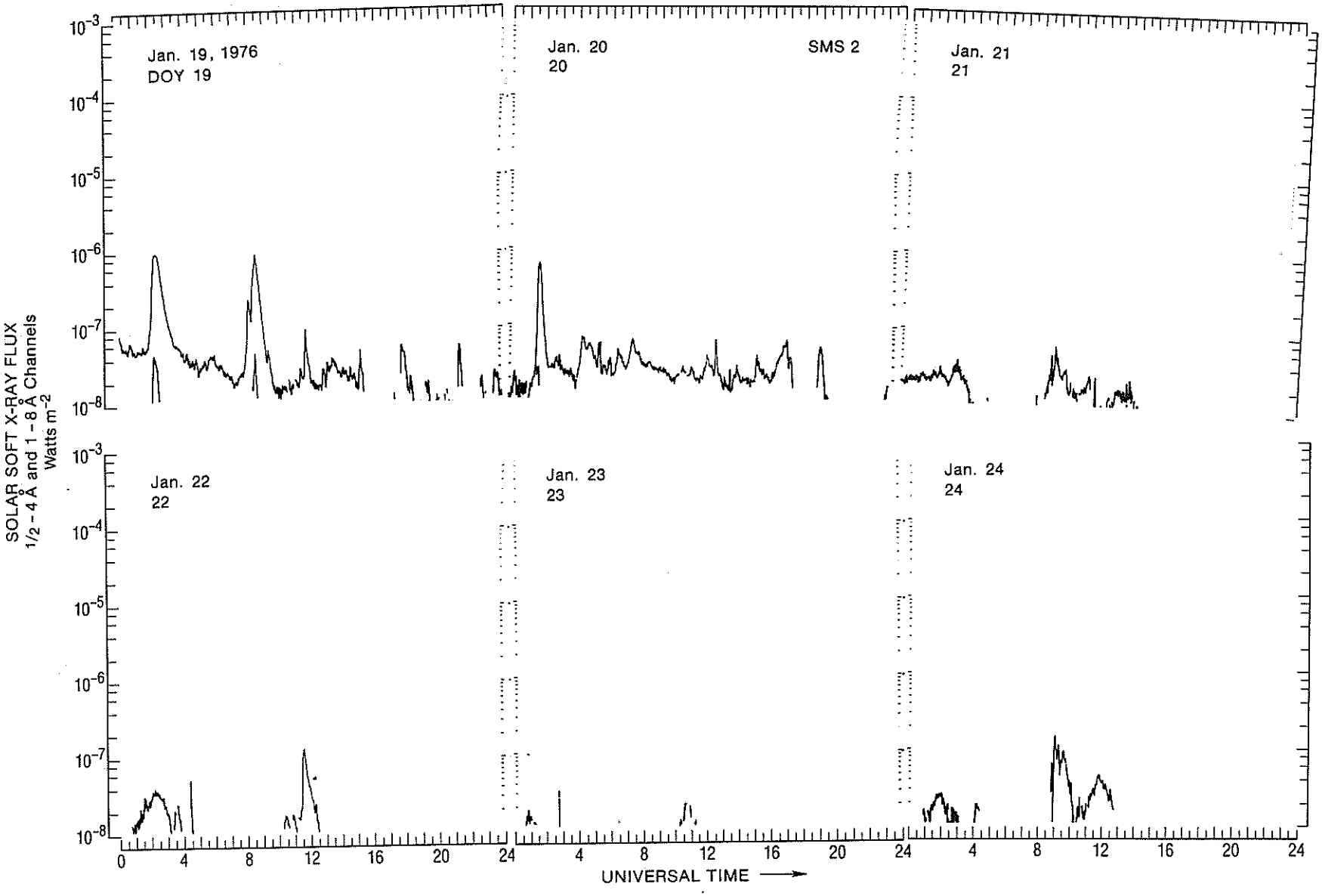


Figure 110. SMS-2 solar X-ray flux for January 19-24, 1976.

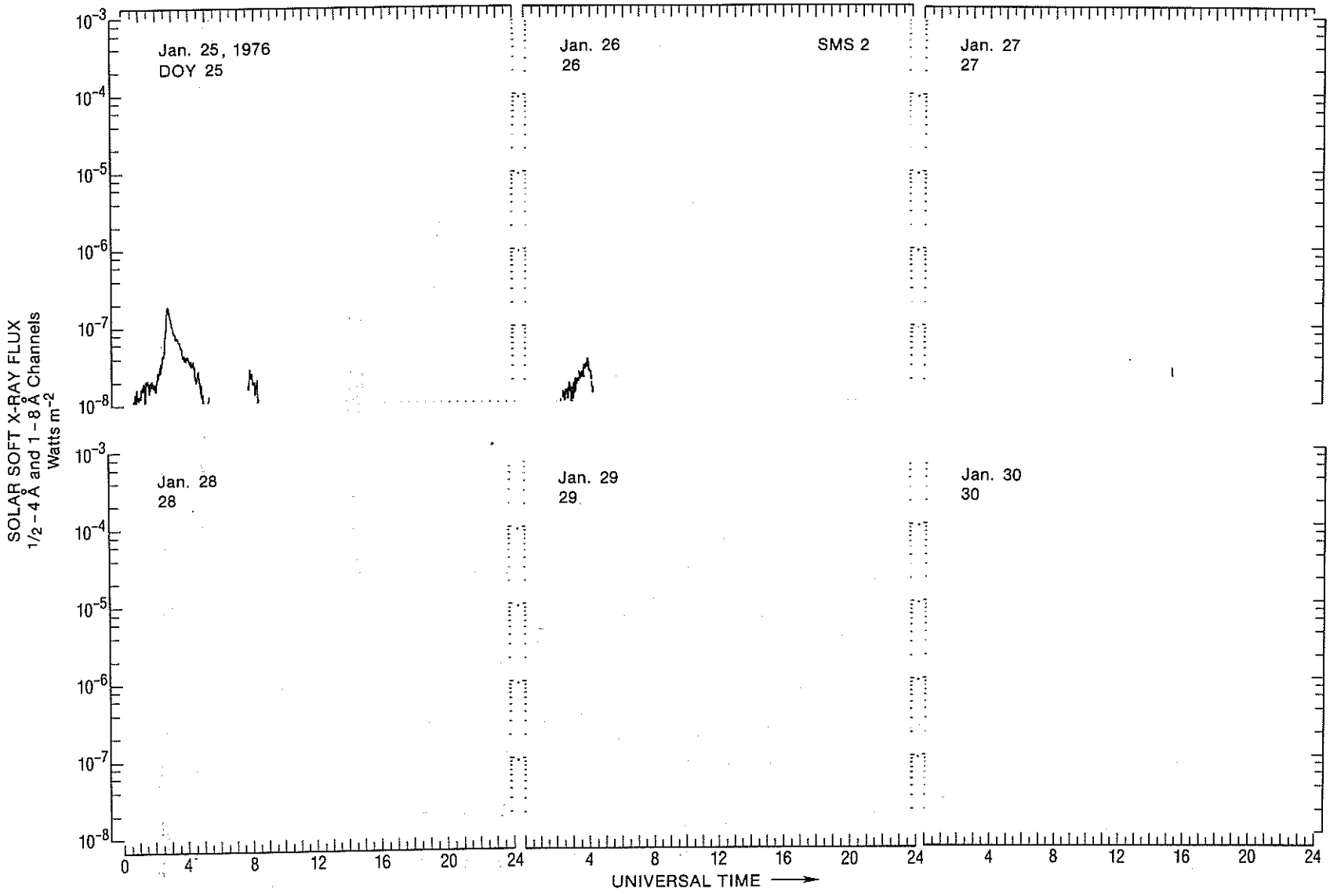


Figure 111. SMS-2 solar X-ray flux for January 25-30, 1976.

outage of about five minutes just after 1300 UT, but in January they were just after 1100 UT. When no trace is evident in the figures, it is usually because the 1-8A flux is $\leq 10^{-8}$ Wm^{-2}. Major outages in the archived X-ray data occurred during the following periods: 0000 UT January 1 to 0027 UT January 2; 1125 - 1201 and 1400 - 1500 UT, January 2; 1007 - 1111 UT, January 3; 0856 - 1004 UT and 1102 - 1438 UT, January 7; 0235 - 0339 UT, January 8; 1102 UT January 11 to 0029 UT January 12; 1033 - 1148 UT and 1906 - 2029 UT, January 13; 0517 - 0553 UT and 1304 - 1327 UT, January 14; 0917 - 1044 UT, January 15; 1839 - 1915 UT, January 20; 1645 - 2321 UT, January 22; 0255 - 0354, 0743 - 0824, 1256 - 1431 and 1523 - 2324 UT, January 23; 1611 - 2319 UT January 26; 1606 - 2356 UT, January 27; 1508 - 2325 UT, January 28; 1504 - 2340 UT, January 29; 0722 - 0757, 0916 - 1031 and 1501 - 2357 UT, January 30; and 1101 - 2256 and 2300 - 2400 UT, January 31. In addition, frequent small outages occurred on January 2 from 0027 - 1800 UT, so frequently that about half of the data was missing from 0100 - 1700 UT. The 1-8A archive data that exist for January 2 are all $\leq 10^{-8}$ Wm^{-2} all day.

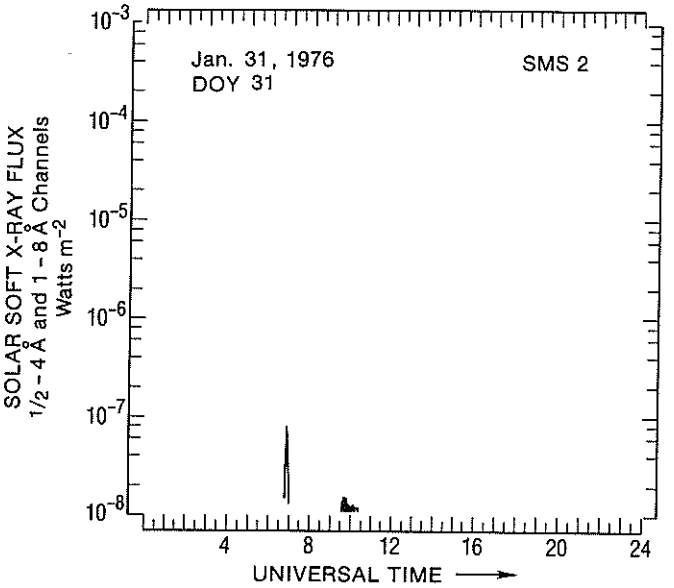


Figure 112. SMS-2 solar X-ray flux for January 31, 1976.

2.20 February 1976, SMS-2

2.20.1 Solar Activity Overview

The solar X-ray flux was very low throughout February except for the occasional microburst evident in figures 113-117.

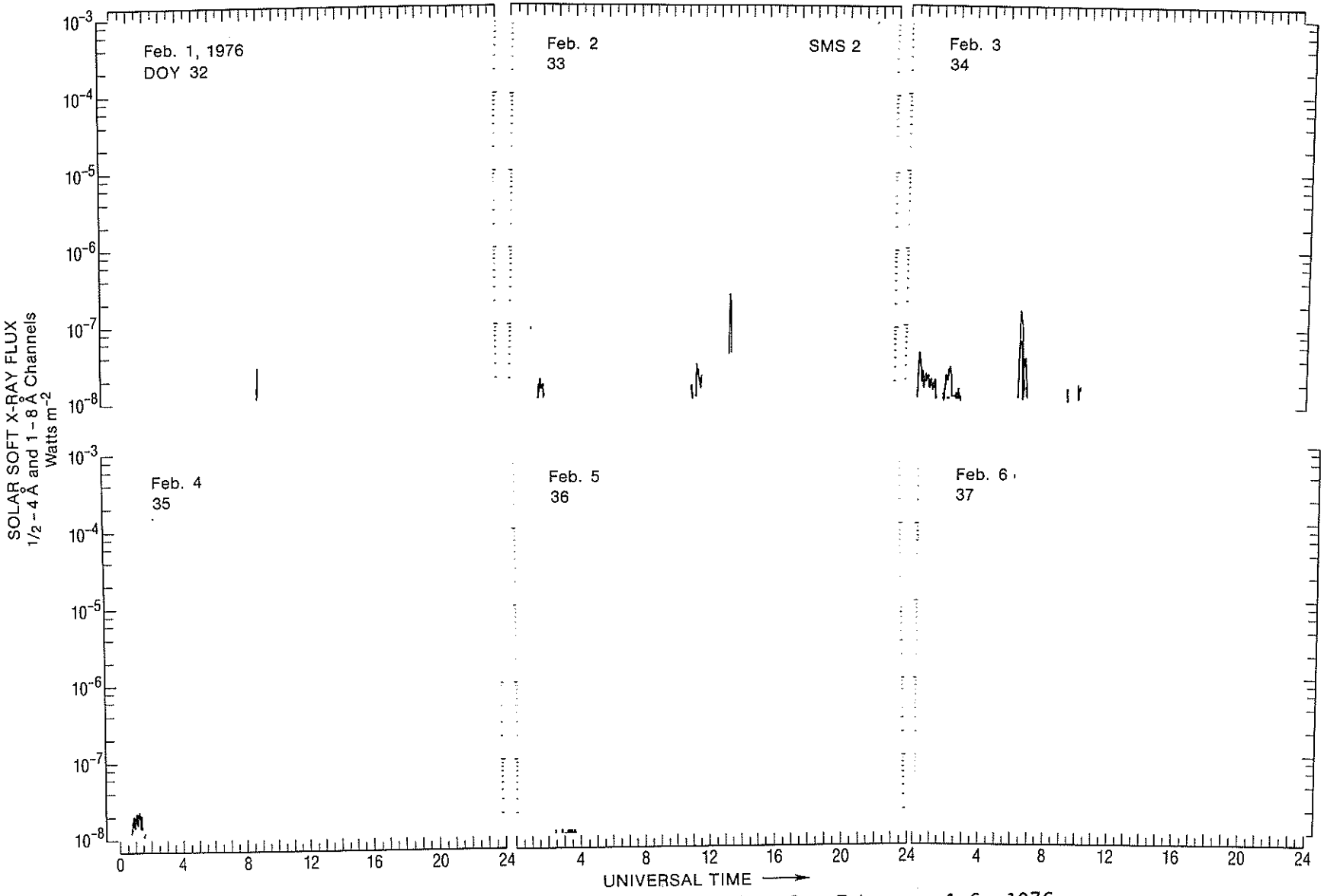


Figure 113. SMS-2 solar X-ray flux for February 1-6, 1976.

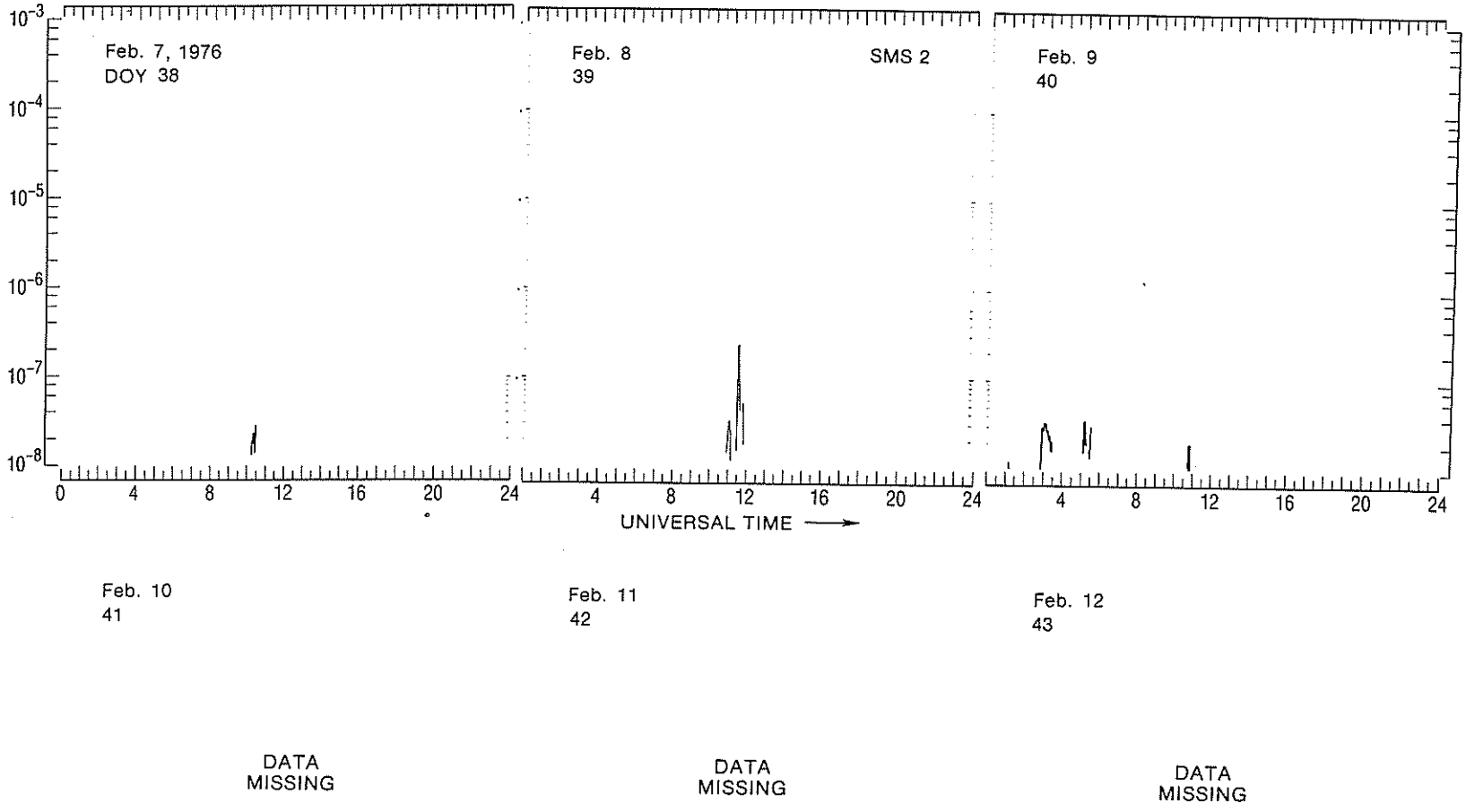


Figure 114. SMS-2 solar X-ray flux for February 7-12, 1976.

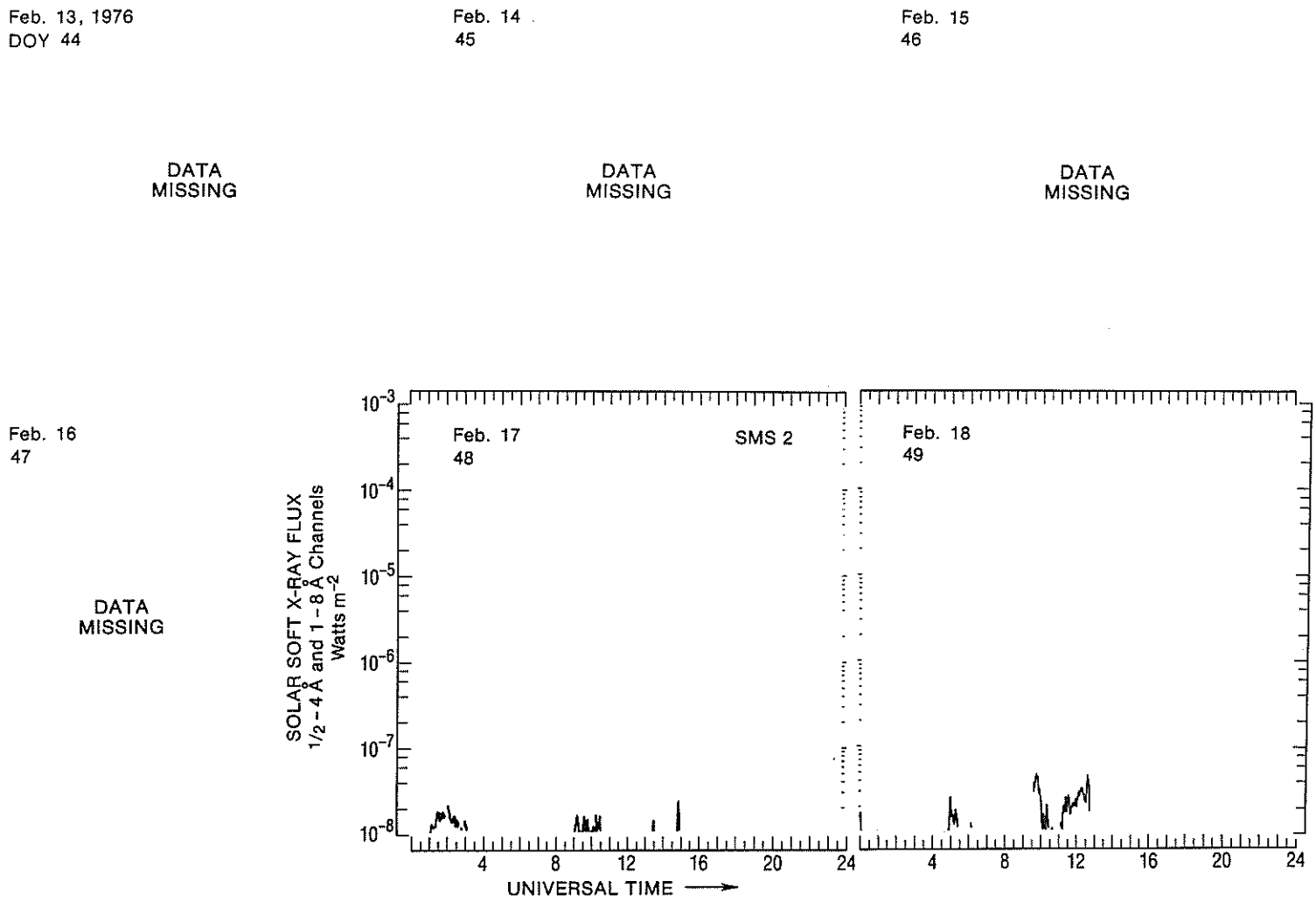


Figure 115. SMS-2 solar X-ray flux for February 13-18, 1976.

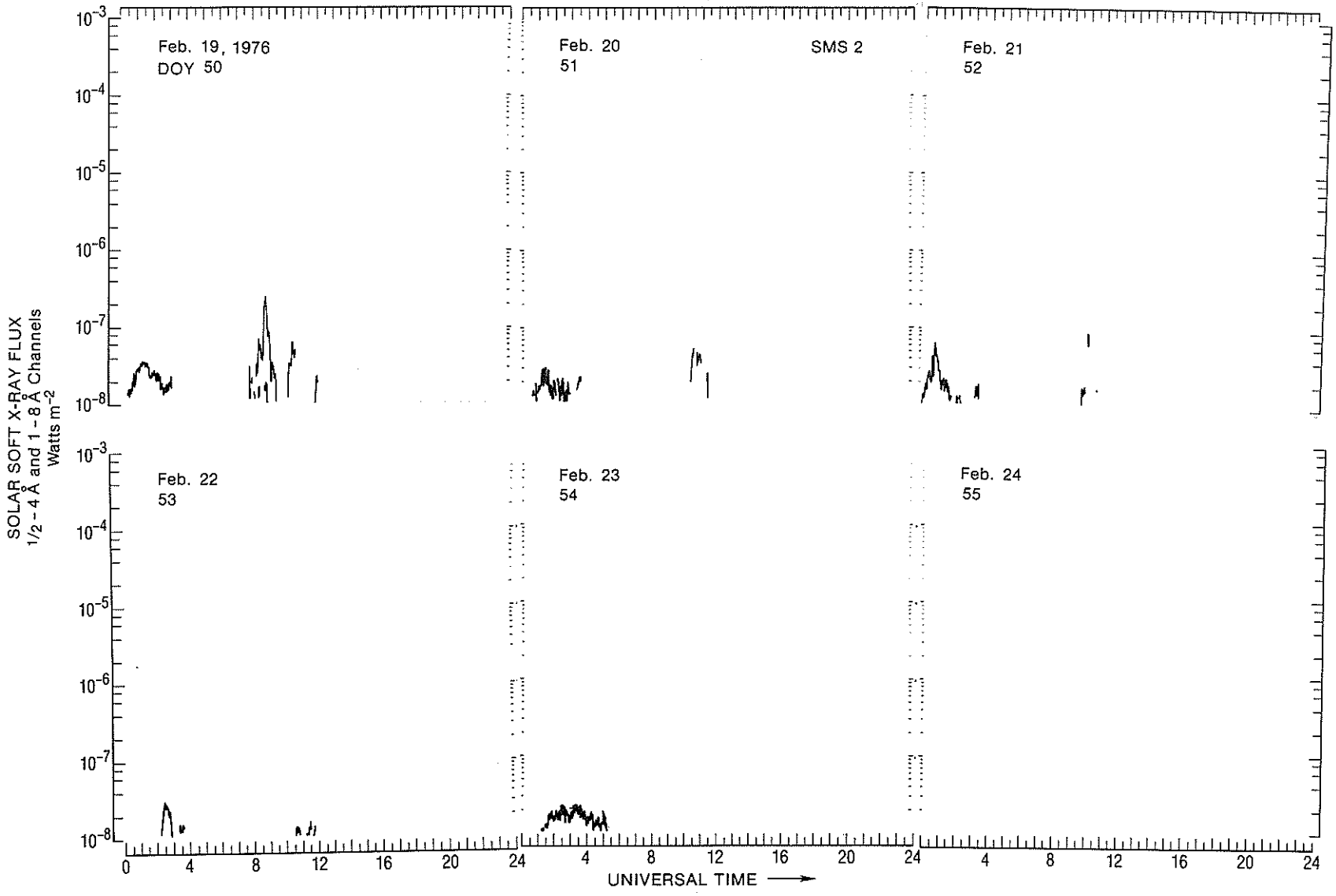


Figure 116. SMS-2 solar X-ray flux for February 19-24, 1976.

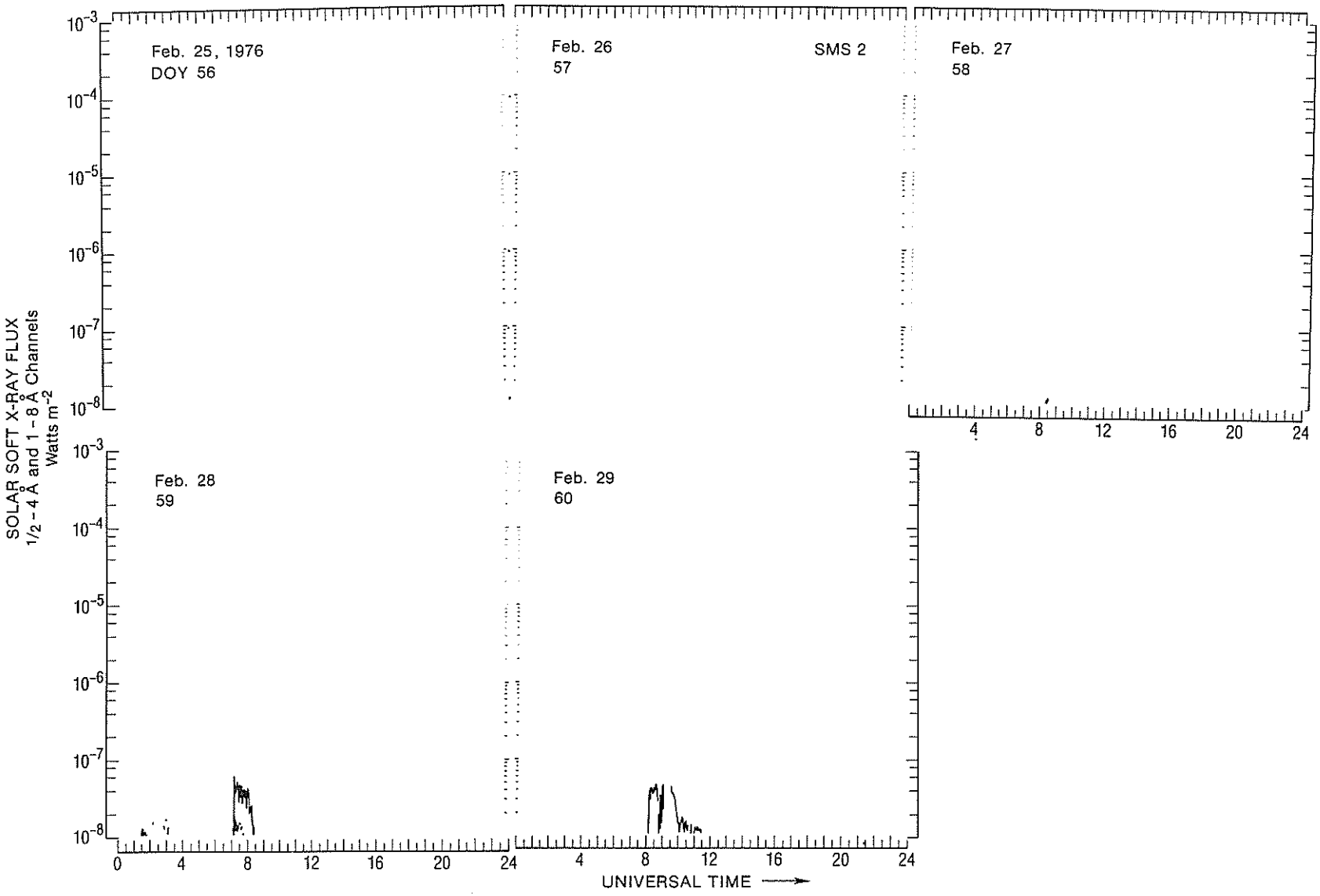


Figure 117. SMS-2 solar X-ray flux for February 25-29, 1976.

2.20.2 Missing Data

Calibrations occurred near 1040 and 2140 UT daily. Major outages occurred during the following periods: 0943 - 1041 UT, plus scattered small outages during 1100 - 1300 and 1800 - 2200 UT, and 1419 - 1727 UT, February 1; 1032 - 1118 UT, February 2; 1101 - 1307 UT, February 3; 1353 - 1439 UT, February 5; 2244 UT February 9 to 0000 UT February 17; 1156 - 1407 UT, February 20; 1108 - 1545 UT, February 21; 0756 - 1022 UT, 1334 - 1503 UT, and 1732 - 2252 UT, February 23; 1356 - 1429 UT, February 24; and 0956 - 1042 UT, February 27.

2.21 March 1976, SMS-2 and GOES-1

2.21.1 Solar Activity Overview

See The solar X-ray flux was very low at the start of March but rose starting on March 17 to high levels on March 21 and to moderate levels on March 20 and March 22 through mid March 30. Flare activity similarly rose to a high level, the highest level since August 1975. Two X-class flares, a half dozen M-class flares and about three dozen C-class flares occurred.

2.21.2 Outstanding Events

Figures 124 and 125 show the X1 flares of March 23 and 28. Note that these X1 flares are not only outstanding in their peak intensity but also in their duration. Note that the decay of the X-class flare of March 28 dominates the solar X-ray flux for a full day. Similarly, the X1 flare dominates the solar flux for half a day. GOES-1 data are shown for the March 23 flare because the SMS-2 data do not show the peak of the event because SMS-2 was in the Earth's shadow.

2.20.3 Missing Data

SMS-2's calibrations occurred for about ten minutes near 1040 and 2140 UT daily. SMS-2 missed solar flux measurements while in the Earth's shadow for about an hour near 0900 UT. According to the GOES-1 data, which encountered

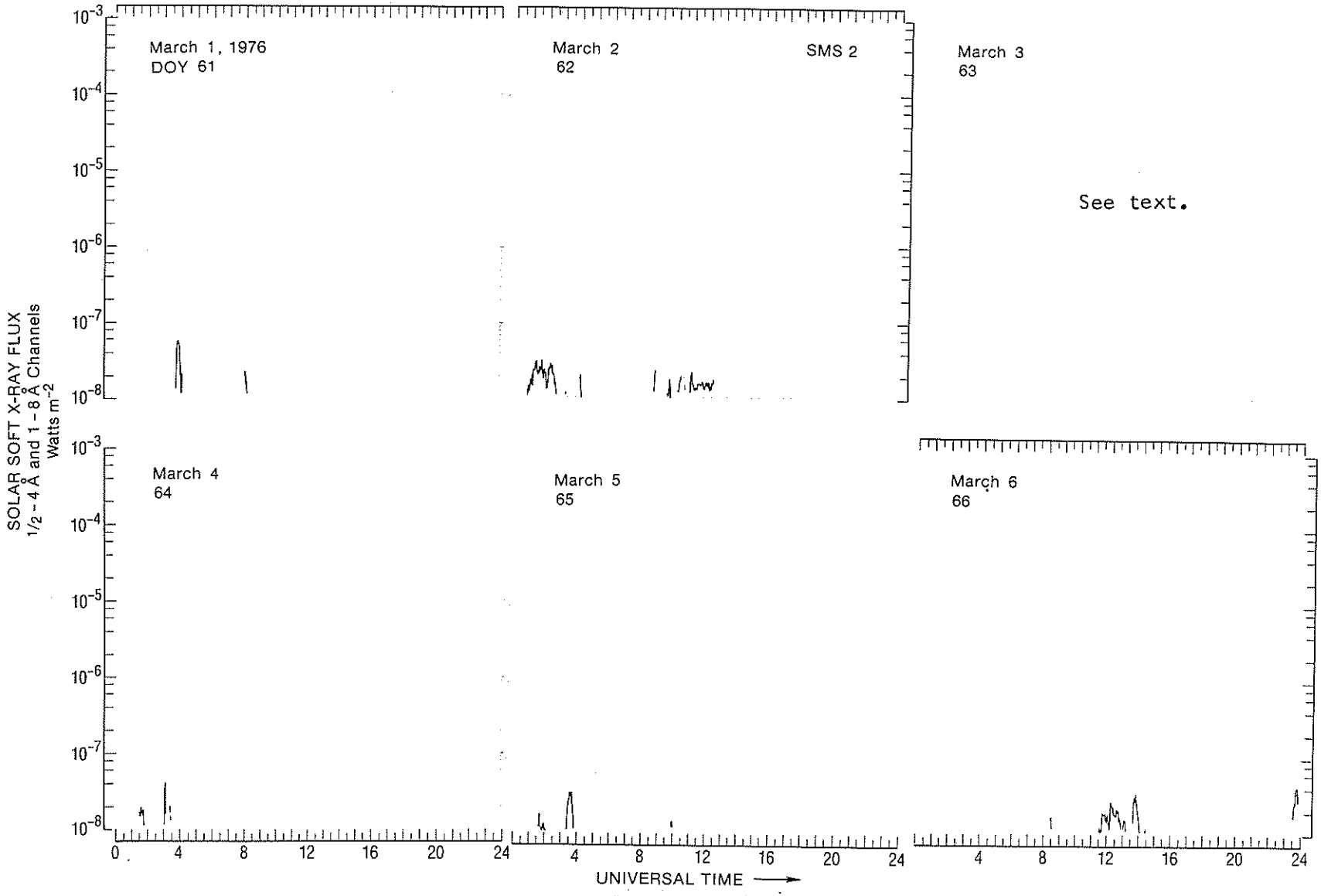


Figure 118. SMS-2 solar X-ray flux for March 1-6, 1976.

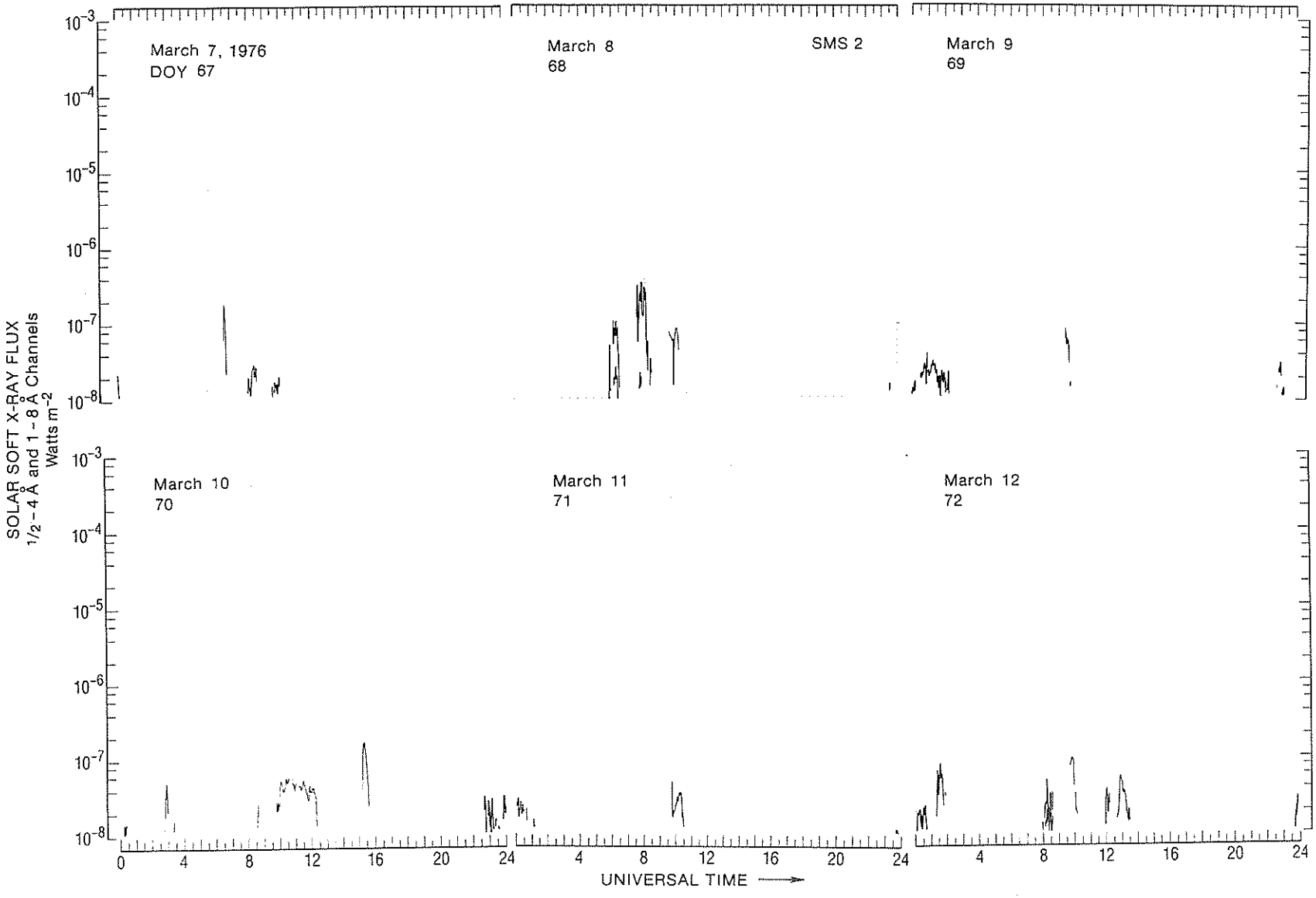


Figure 119. SMS-2 solar X-ray flux for March 7-12, 1976.

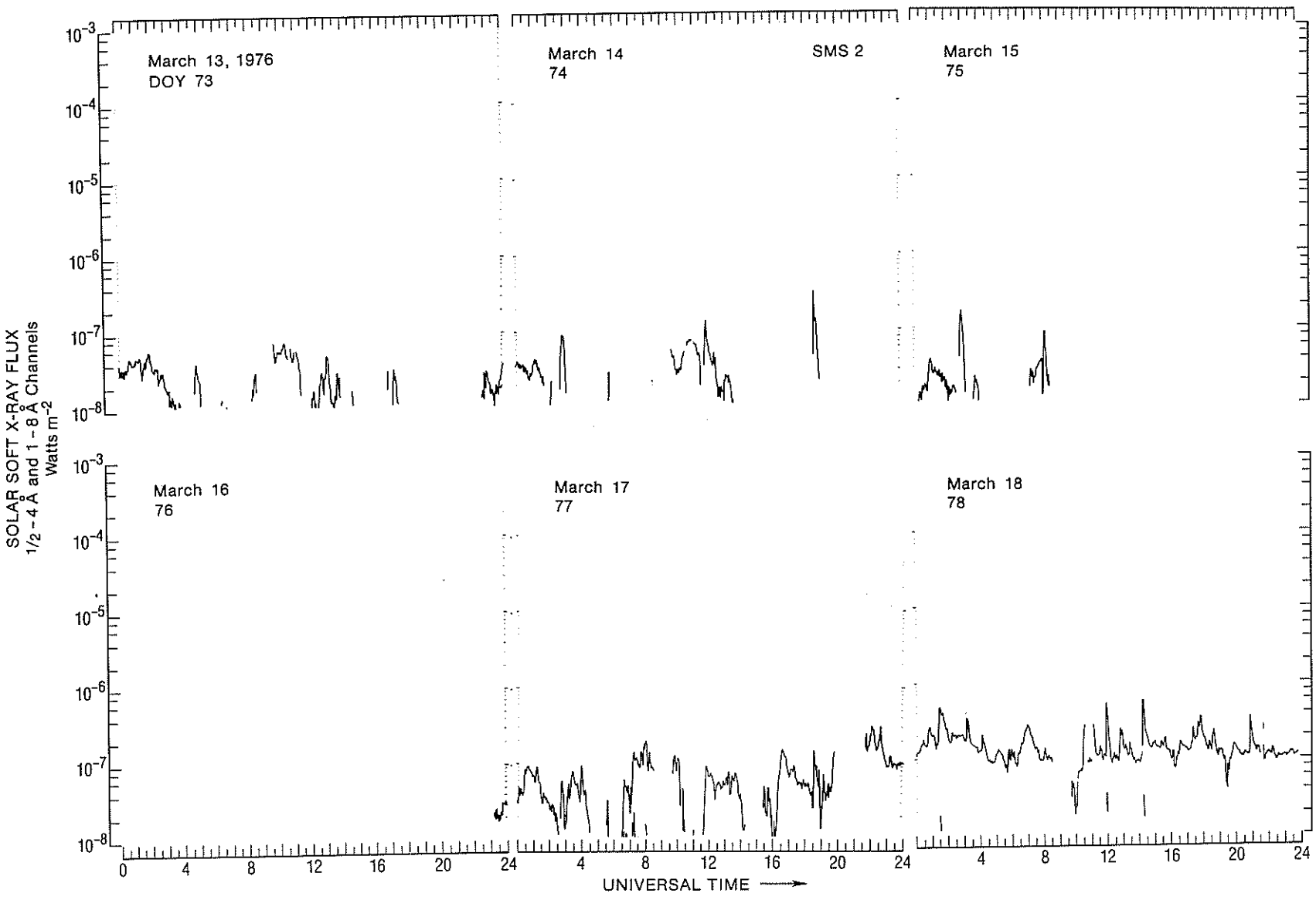


Figure 120. SMS-2 solar X-ray flux for March 13-18, 1976.

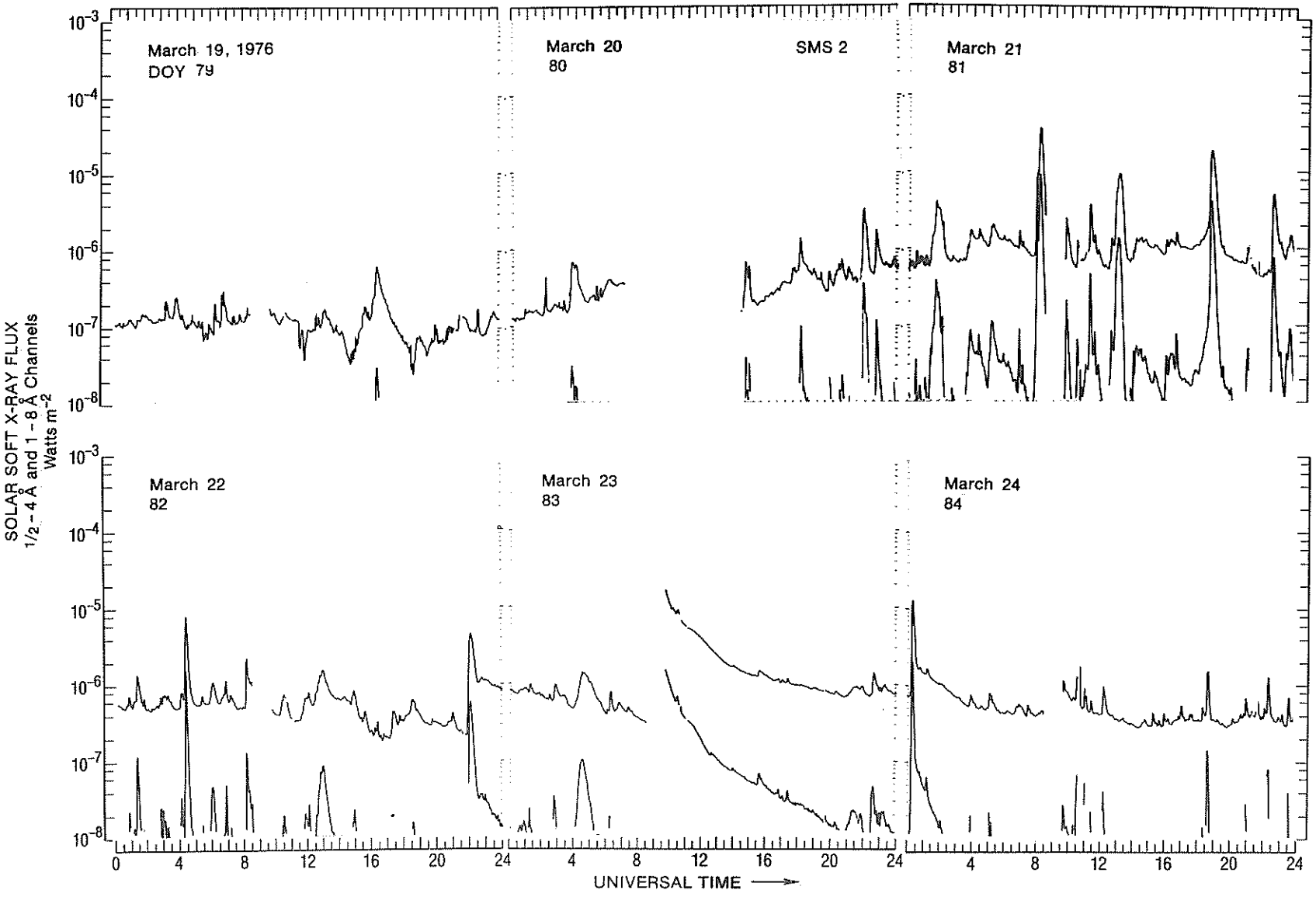


Figure 121. SMS-2 solar X-ray flux for March 19-24, 1976.

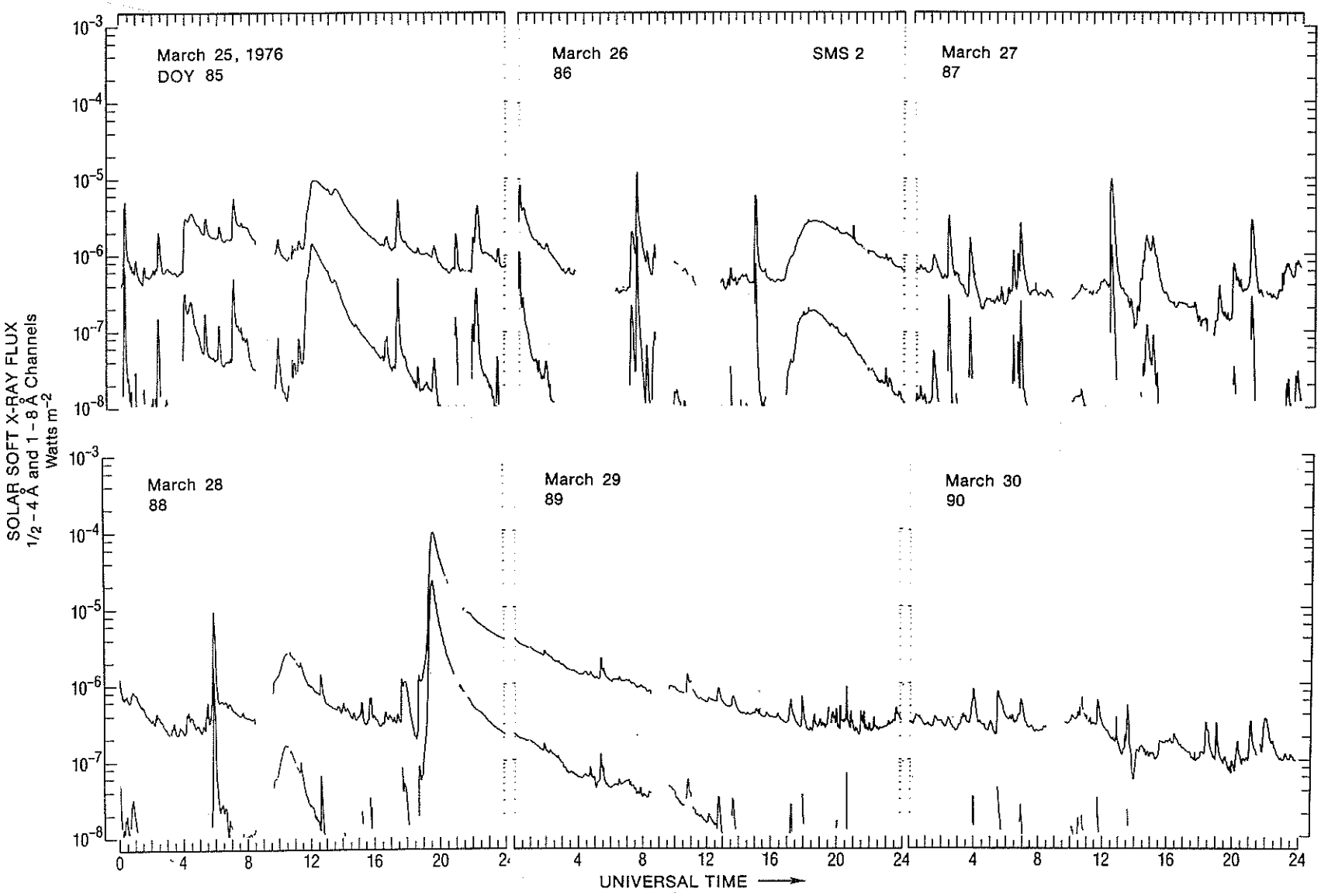


Figure 122. SMS-2 solar X-ray flux for March 25-30, 1976.

the Earth's shadow near 0500 UT instead of 0900 UT, SMS-2 missed no major events while in the Earth's shadow, except for the X1 flare of March 23, for which the GOES-1 data are shown in Figure 124, and a C2 flare near 0930 UT, March 24. Outages in the SMS-2 data are evident in figures 120-123 after March 17 as gaps in the curve of X-ray flux. During the midday gap on March 20, only one C2 spike flare occurred near 0800 UT, according to the GOES-1 data. During the gap on March 26, GOES-1 archive data also suffered an outage. The sharp dip in the 1-8A flux just after 1800 UT on March 27 did not occur in the GOES-1 data and therefore is probably not a feature in the solar X-ray flux but is some contamination in the SMS-2 measurements. At 1-8A flux levels below 10^{-7} Wm^{-2}, the SMS-2 and GOES-1 measurements do not agree in their detailed temporal structure except that small flares occur concurrently in the two sets of observations. However, other dissimilar slower variations, some of which are diurnally recurrent, must not be temporal variations in the solar X-ray flux but are probably caused by magnetospheric energetic particles. Major outages in SMS-2 data before March 17 are as follows: 1101 - 1135 and 1415 - 1455 UT, March 3; 2239 - 2319 UT, March 8; 0352 - 0630 UT, March 9; 1418 - 1457 UT, March 12; and 0849 UT March 15 to 1440 UT March 16.

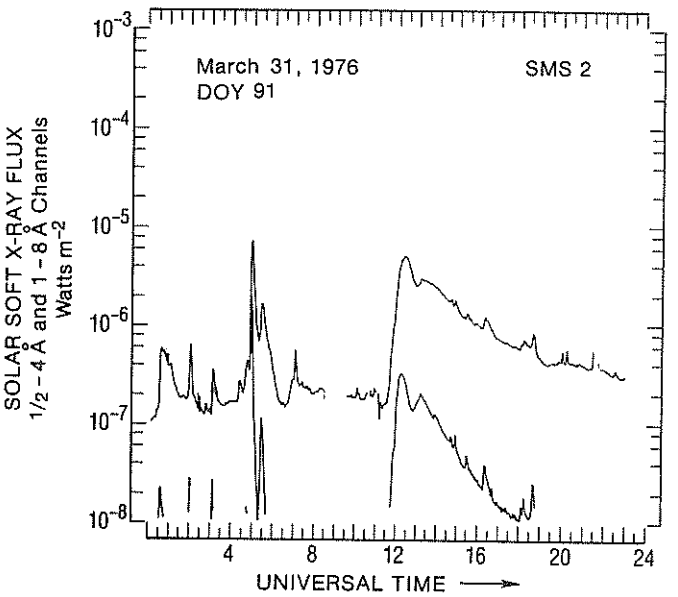


Figure 123. SMS-2 solar X-ray flux for March 31, 1976.

2.22 April 1976, SMS-2 and GOES-1

2.22.1 Solar Activity Overview

The solar X-ray flux varied from low to very low levels in figures 126-128. In figure 129, a small round of low activity occurred with several C-class flares followed by an X1 flare in figure 130 is the high point for the

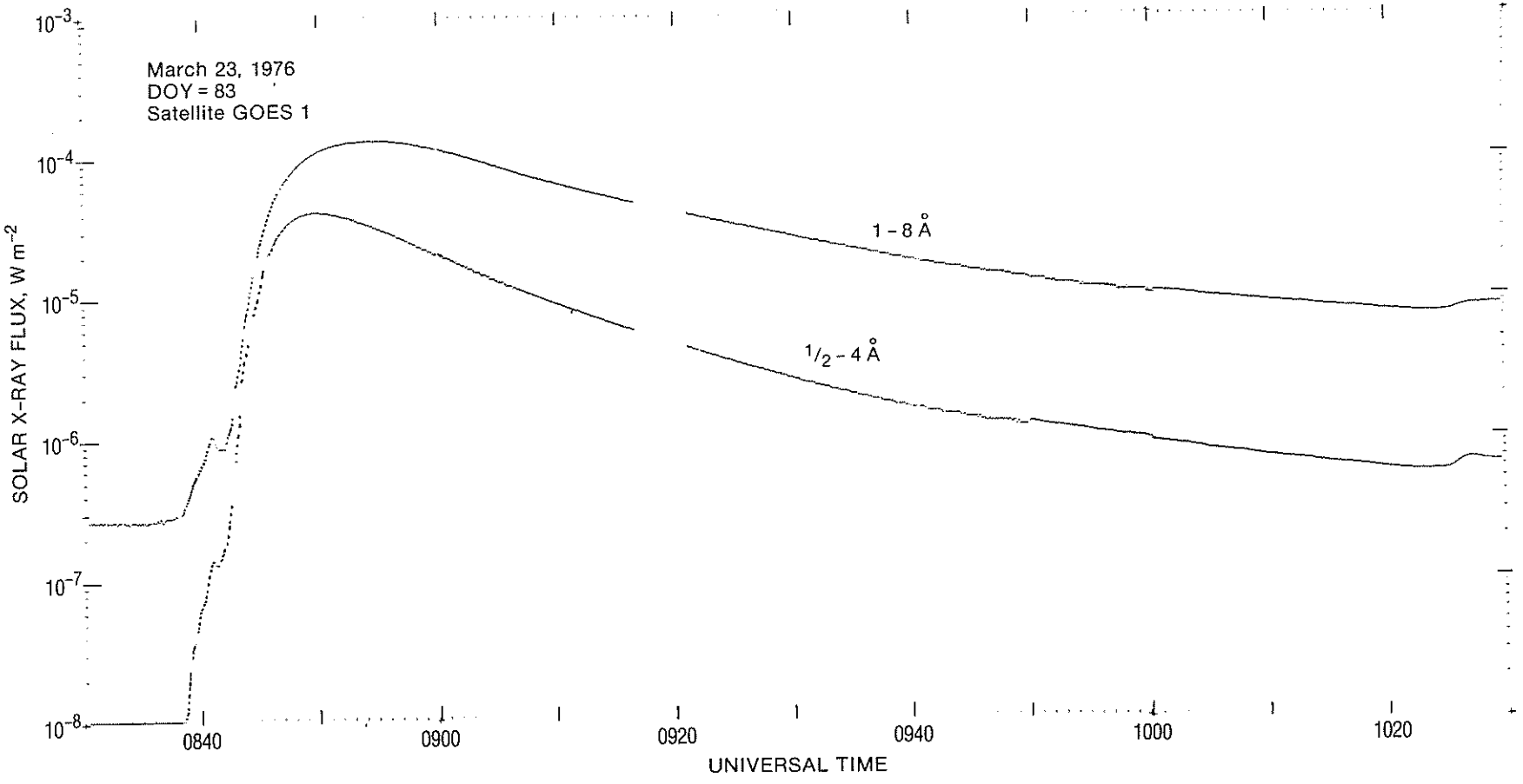


Figure 124. The X1 solar X-ray burst of 0855 UT, March 23, 1976.

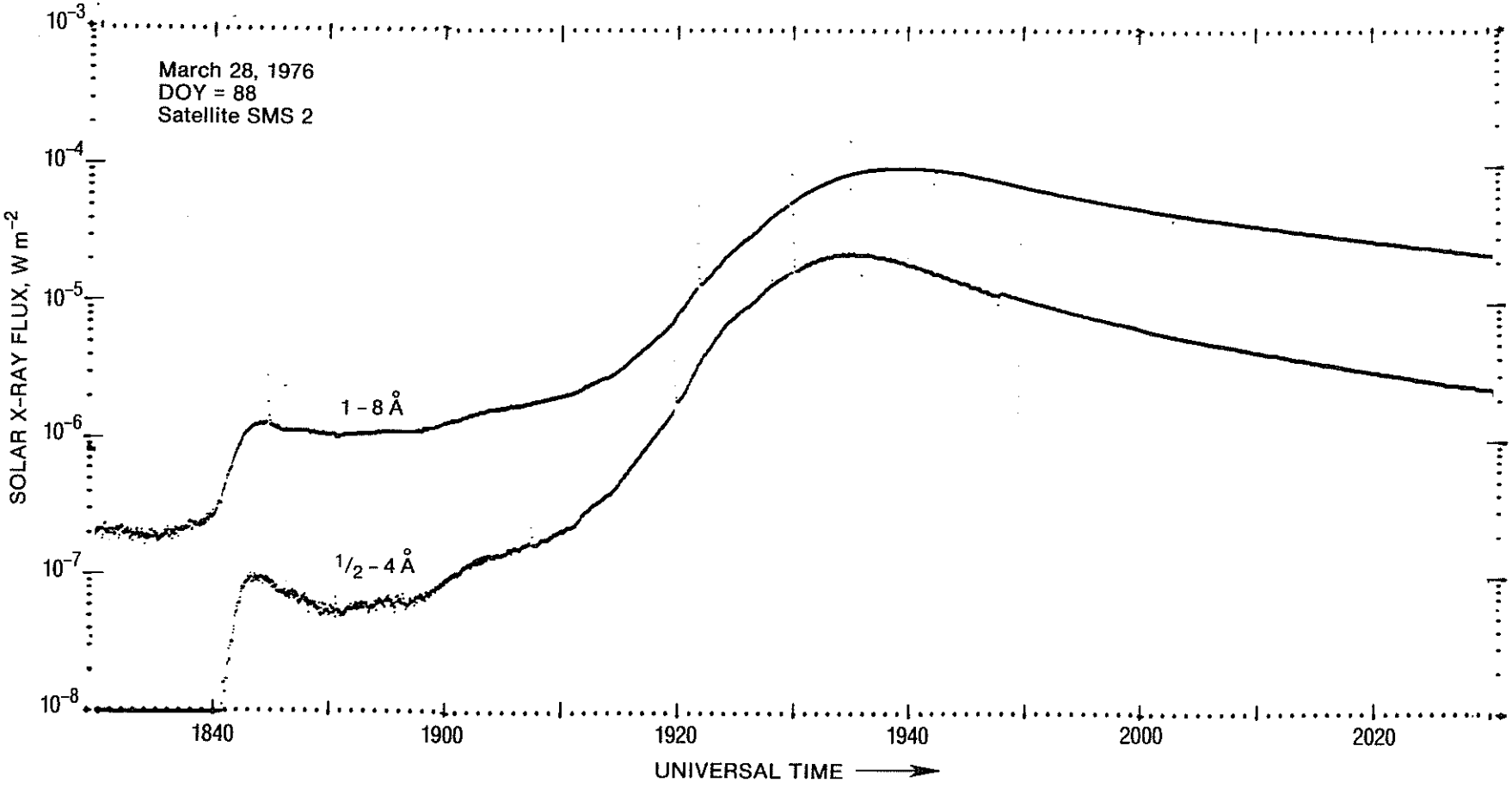


Figure 125. The X1 solar X-ray burst of 1939 UT, March 28, 1976.

month. Note that the general build-up of activity before this X-class flare is much smaller than for the X-class flares in March.

2.22.2 Outstanding Event

Figure 131 illustrates the X1 flare of April 30, 1976. Note the rapid rise from low flux levels. Note also the initial rapid decay that shifts to a slow decay as shown in figures 130 and 132. This is the last X-class flare in 1976.

2.22.3 Missing Data

Calibrations continued to be made daily near 1040 and 2140 UT. SMS-2 was in the Earth's shadow and therefore did not observe the solar X-ray flux for about an hour near 0900 UT on April 1, decreasing to no effect starting on April 13. Most of the time when the X-ray curve is not present in figures 126-130, the 1-8A flux was $\leq 10^{-8}$ Wm^{-2}. Major outages in SMS-2 data occurred during the following periods: 0813 - 1422 UT, April 3; 1934 - 2004 UT, April 5; 1934 - 2039 UT, April 6; 0106 - 0139 UT and 0840 - 1326 UT, April 8; 0636 - 0707 UT, April 11 (GOES-1 data indicate no significant events occurred during this time); 2150 - 2259 UT, April 13 (GOES-1 indicates no events); 0000 - 1841 UT and 2300 - 2338 UT, April 14 (GOES-1 data indicate a flare smaller than C1 occurred near 1430 UT); 2135 - 2400 UT, April 15 (GOES-1 shows the 1-8A flux was below 4×10^{-8} Wm^{-2}); 1357 - 1446 UT, April 16 (GOES-1 shows the X-ray flux was nearly level); 1245 - 1332 UT, April 18; GOES-1 indicates a small microburst occurred during the second gap in SMS-2 data in figure 129 on April 20; 0311 - 0350 UT, April 29; and 2300 - 2400 UT, April 30. SMS-2 data have been found for the midday gap on April 30 in figure 130 when a C3 flare occurred at 1247 UT.

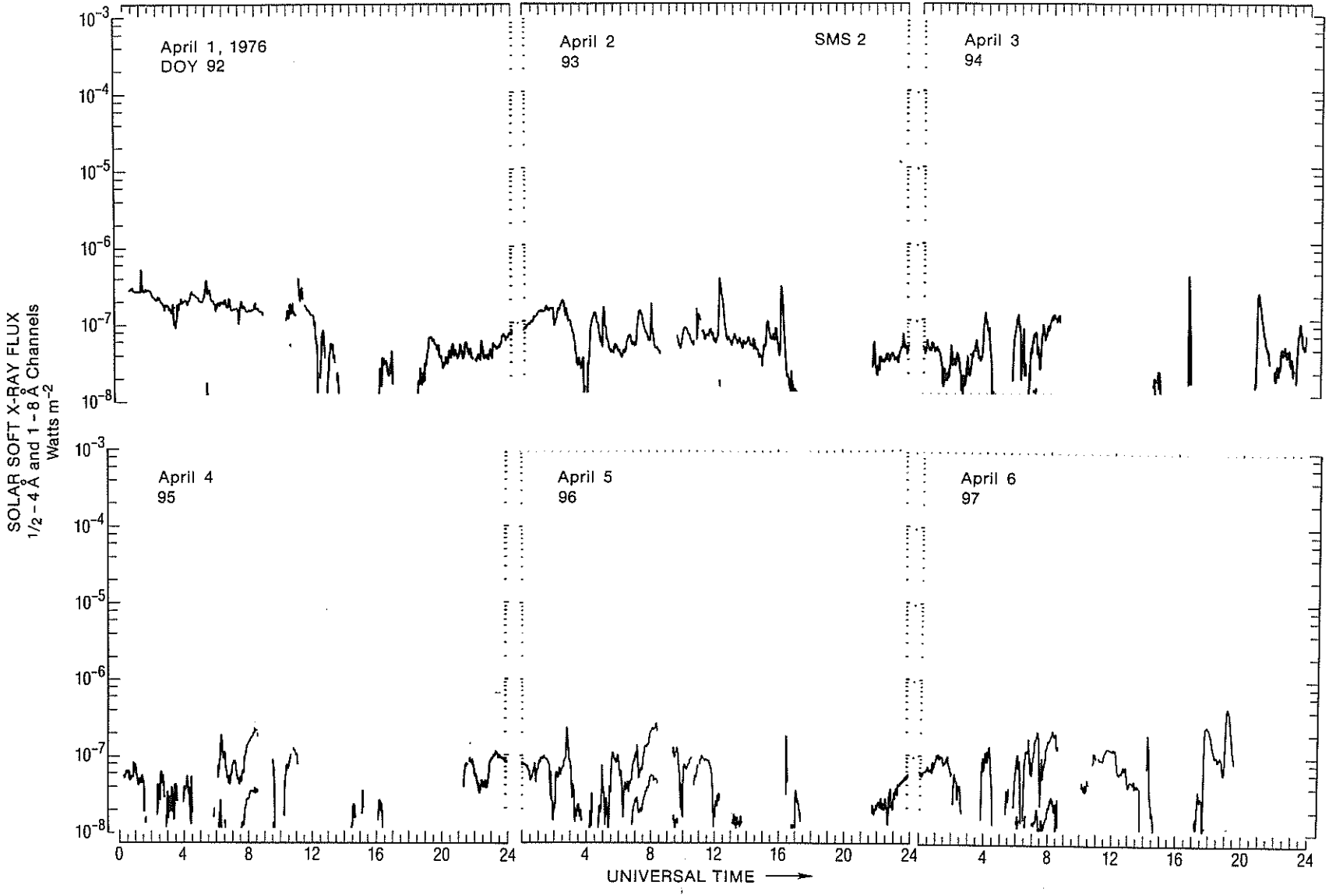


Figure 126. SMS-2 solar X-ray flux for April 1-6, 1976.

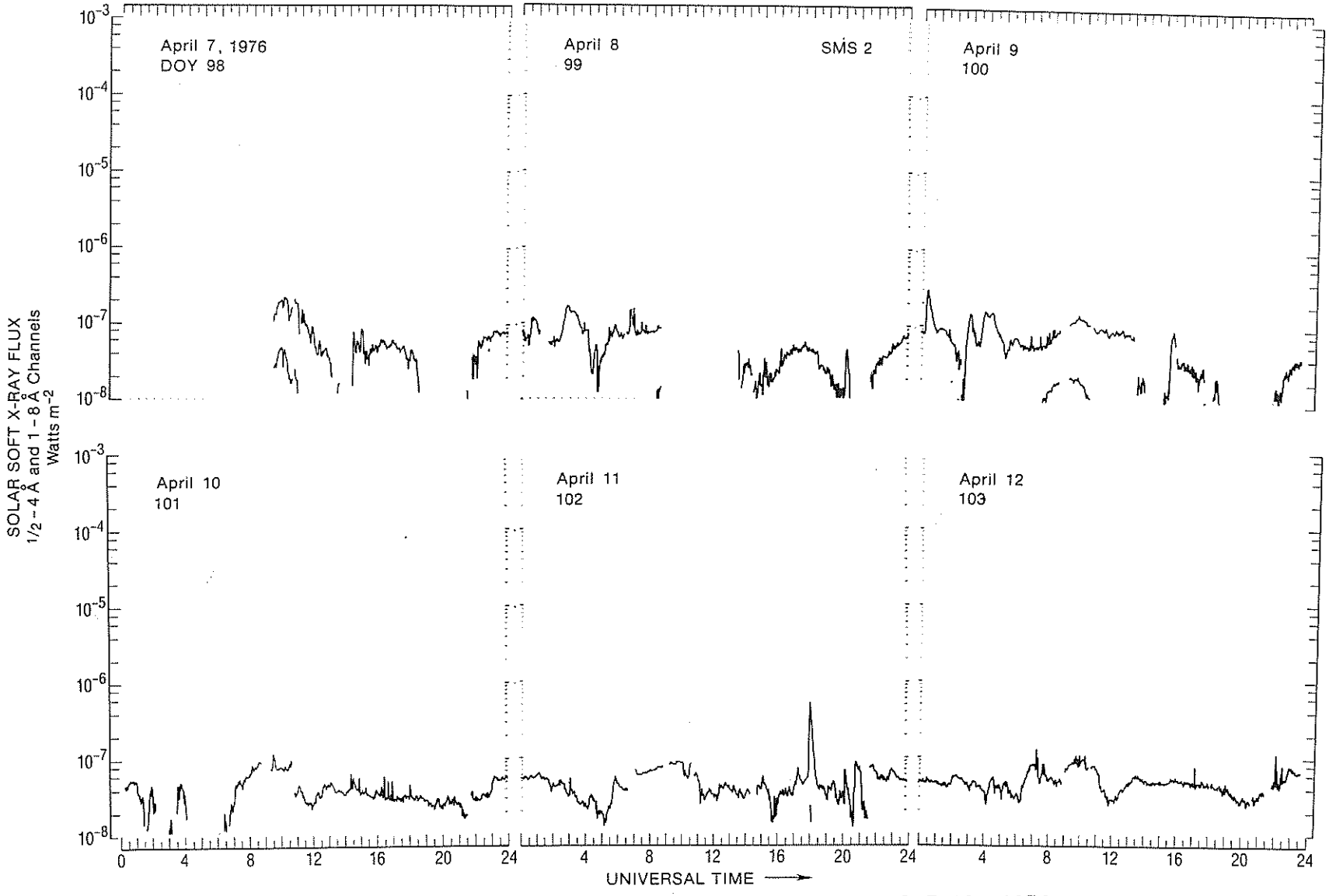


Figure 127. SMS-2 solar X-ray flux for April 7-12, 1976.

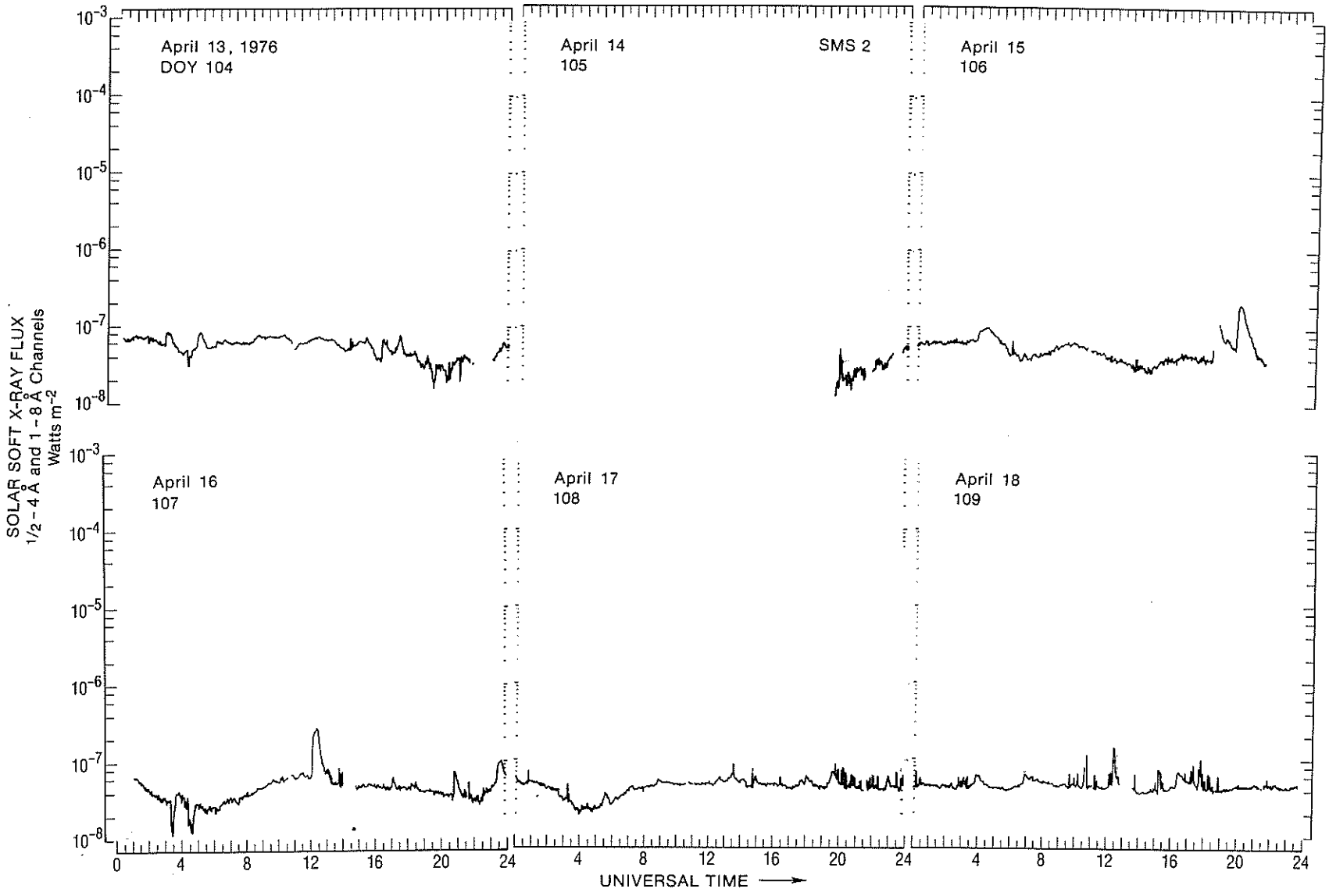


Figure 128. SMS-2 solar X-ray flux for April 13-18, 1976.

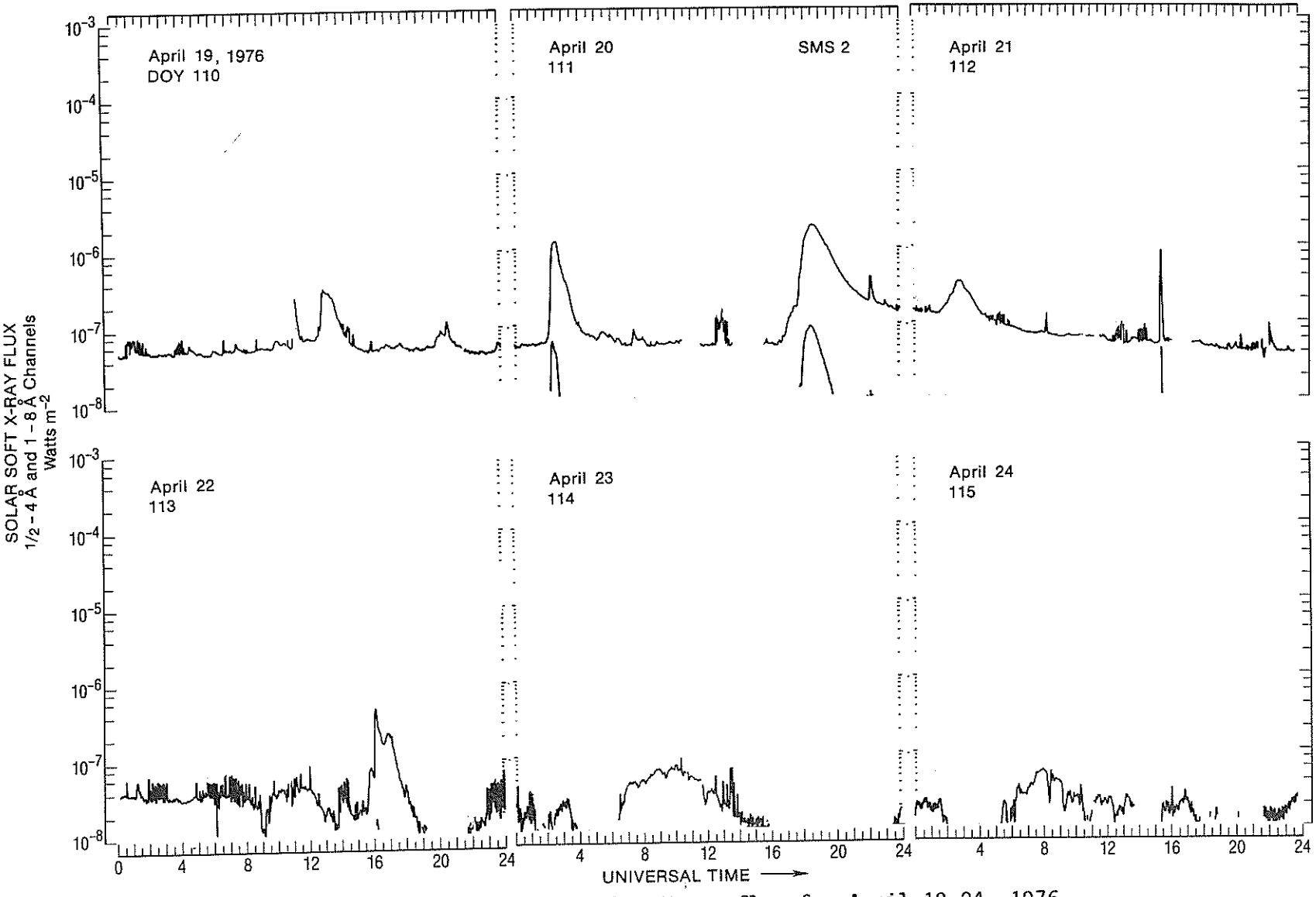


Figure 129. SMS-2 solar X-ray flux for April 19-24, 1976.

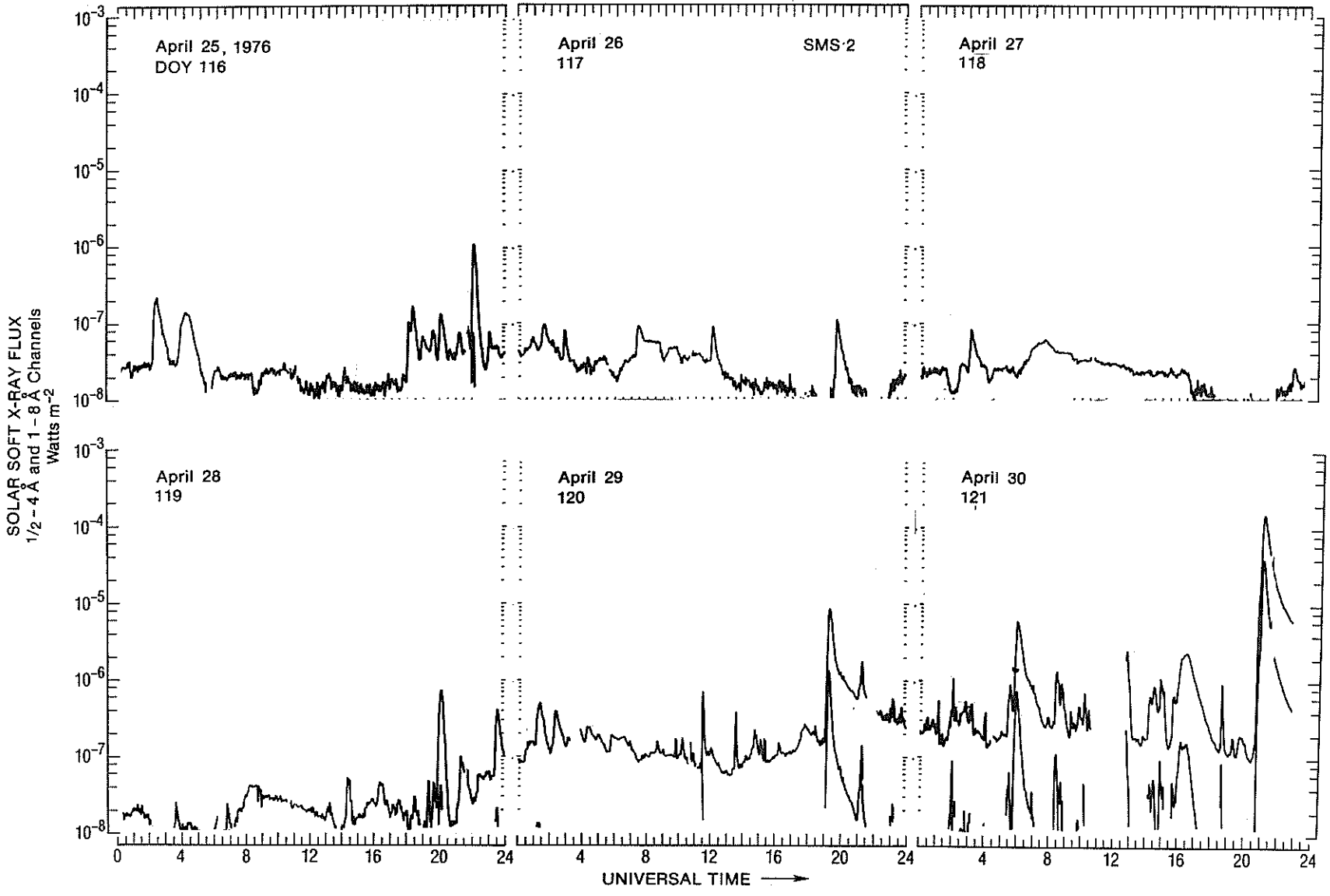


Figure 130. SMS-2 solar X-ray flux for April 25-30, 1976.

2.23 May 1976, SMS-2 and GOES-1

2.23.1 Solar Activity Overview

The X flare at the end of April continued to decay throughout most of May 1, which in turn ended with a C-class flare that decayed through the early portion of May 2. See figures 132-137. The solar X-ray flux continued to decay to very low flux levels from May 5 to May 10. Then a slow rise in X-ray flux occurred with flaring on May 15-18, the largest being small C-class X-ray bursts. The recording of SMS-2 data was interrupted near 1700 UT on May 18, so subsequent figures show GOES-1 data for the next three months. SMS-1 data indicate that the flare on May 21 in figure 135 was observed by GOES-1 starting at the peak of the C5 flare and continuing through the decay of the event. SMS-1 data show an essentially equal secondary maximum at 1256 UT with the start time near 1235 UT. During the rest of the month the apparent X-ray flux was very low except for diurnally recurrent structure, e.g., near 0100, 0700, and 1700 UT, that is probably caused by energetic magnetospheric particles rather than by the solar X-ray flux.

2.23.2 Missing Data

GOES-1 data show that the solar X-ray flux decay smoothly during the first gap near 0100 UT in the figure for May 1, that no significant event occurred during the small gap near 1535 UT, and that the flux rose smoothly during gap in the rise of the flare near 2200 UT. Major outages in the SMS-2 measurements occurred during the following periods: 1654 - 1928 UT, May 3; 0848 - 1152 UT, May 5; 1018 - 1153 UT, May 6; 1101 - 1332 UT, May 7; 1131 - 1516 UT, May 8; 0758 - 1216 UT, May 9; 2152 - 2222 UT, May 10; 1618 - 2042 UT, May 12; 1611 - 2212 UT, May 14; and 0221 - 0345 UT, May 18. Major outages in the GOES-1 X-ray measurements occured during and near the following hours: 14 - 17 UT, May 19; 14 - 21, May 20; 04 - 12 UT, May 20; 04 - 12 UT, May 21; 7 - 9 and 11 - 12 UT, May 29; 0 - 2, 9 - 13, and 23 UT, May 30; and 0 and 23 UT, May 31. SMS-1 data indicated very low X-ray flux levels during these outages in GOES-1 data except SMS-1 also suffered from outages during the following hours: 0 - 2 and 9 - 13 UT, May 30; and 23 UT, May 31.

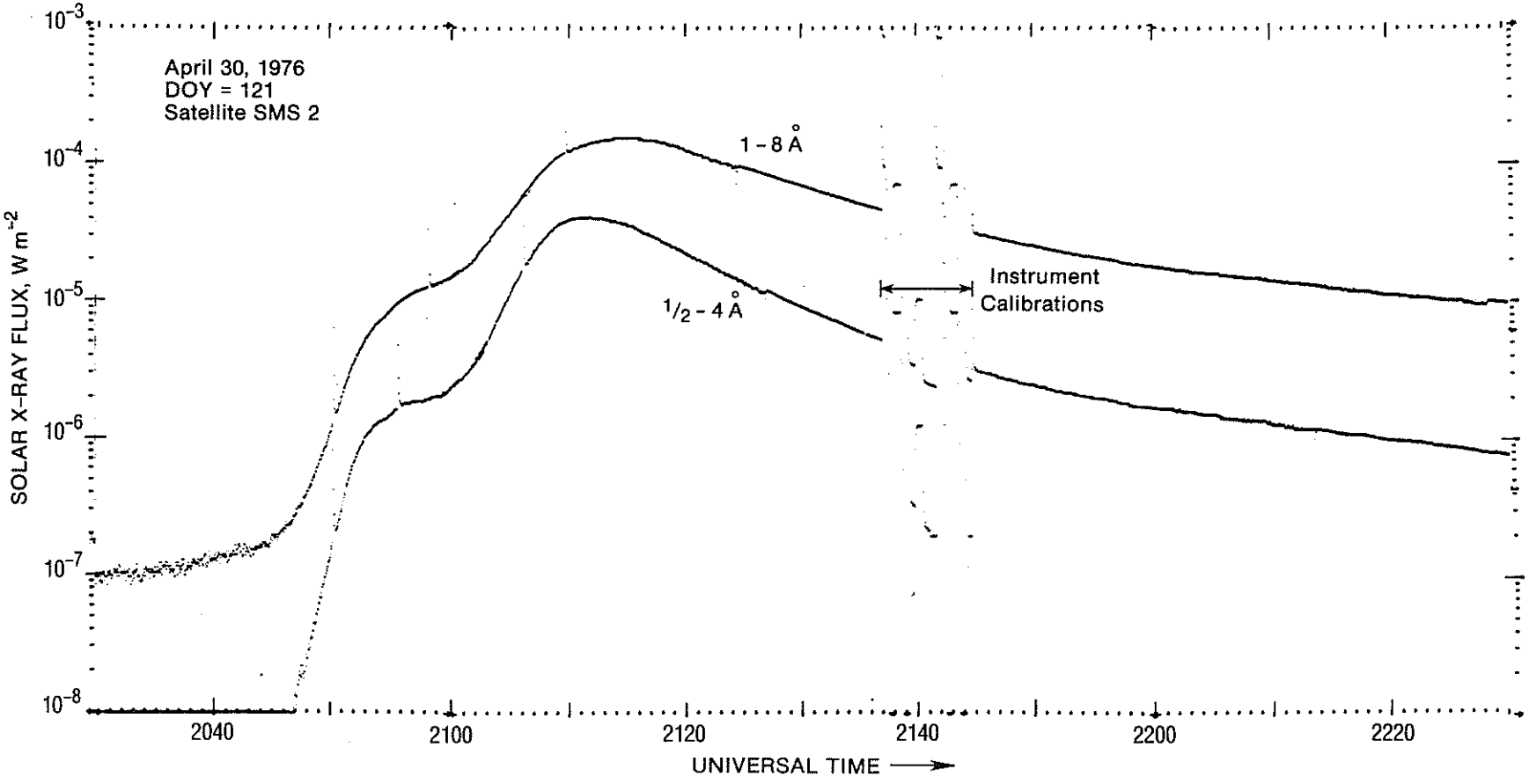


Figure 131. The X1 solar X-ray burst of 2115 UT, April 30, 1976.

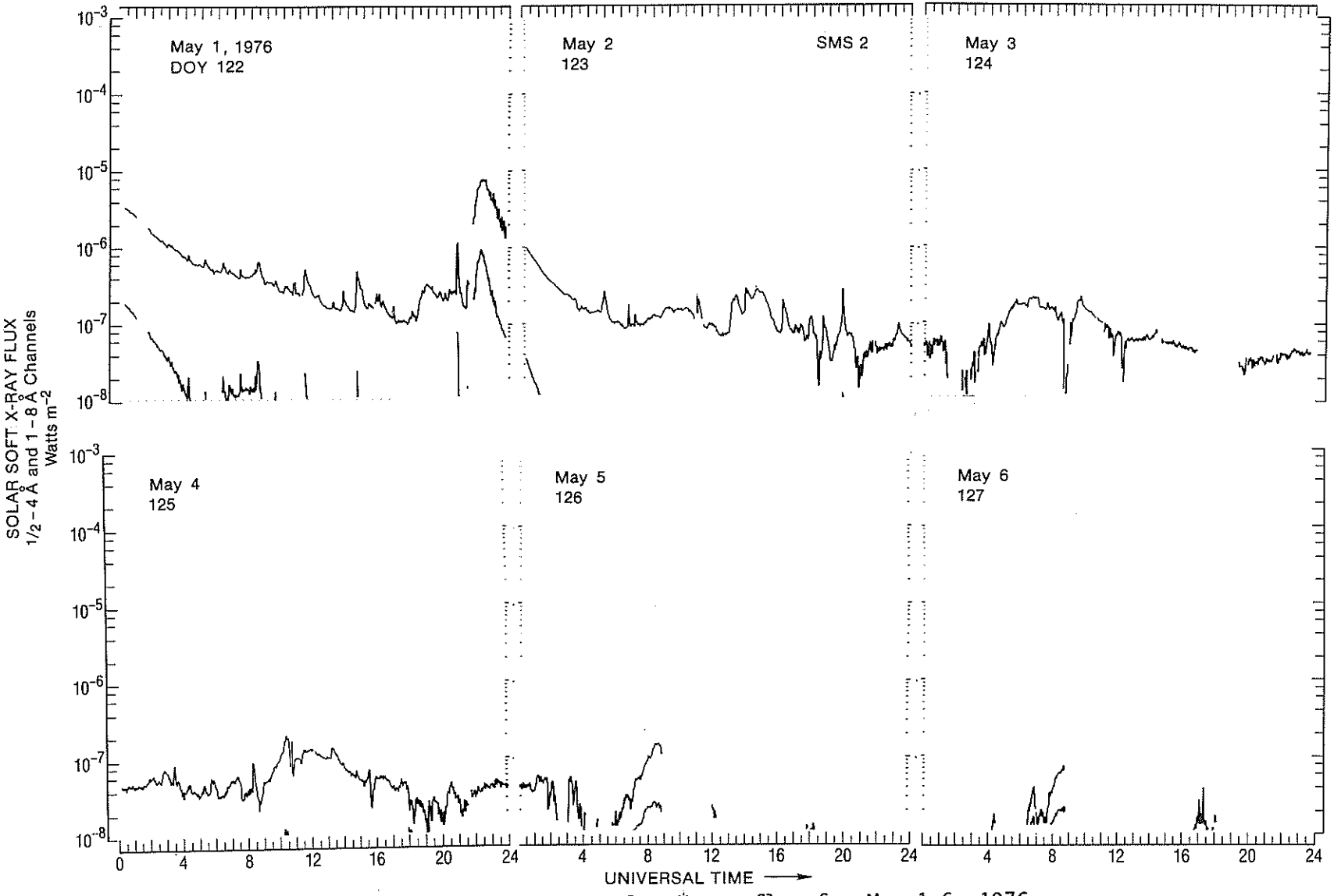


Figure 132. SMS-2 solar X-ray flux for May 1-6, 1976.

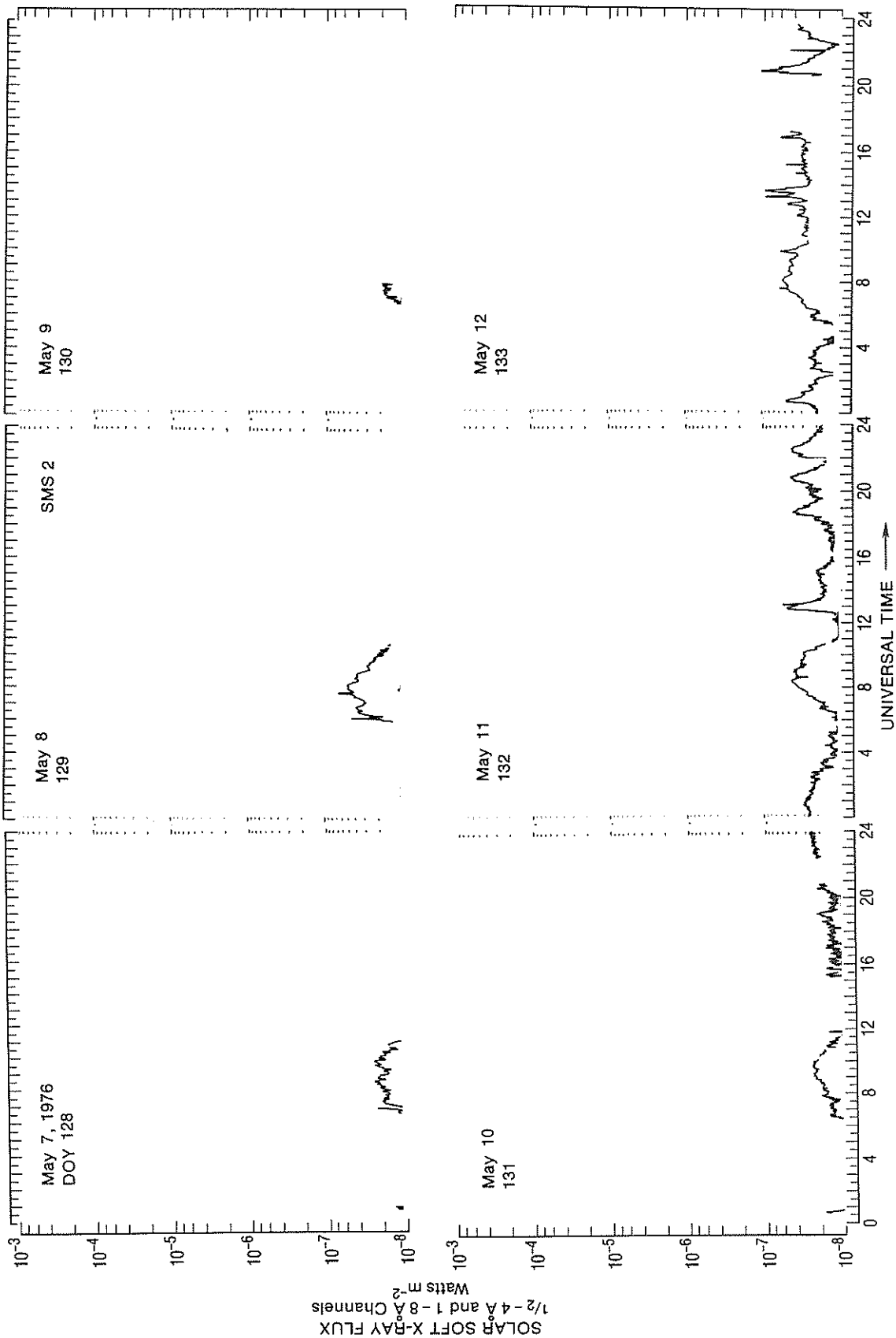


Figure 133. SMS-2 solar X-ray flux for May 7-12, 1976.

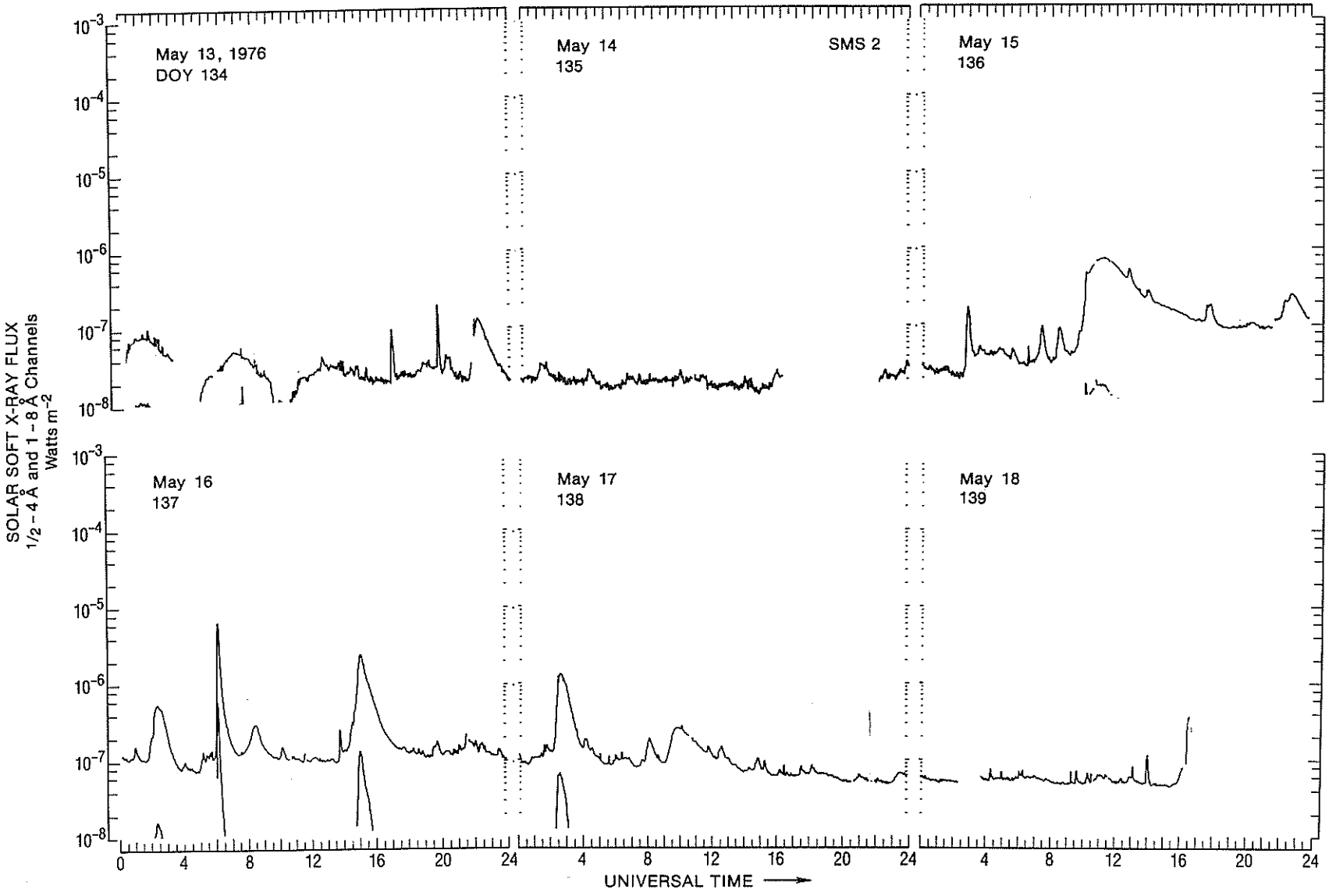


Figure 134. SMS-2 solar X-ray flux for May 13-18, 1976.

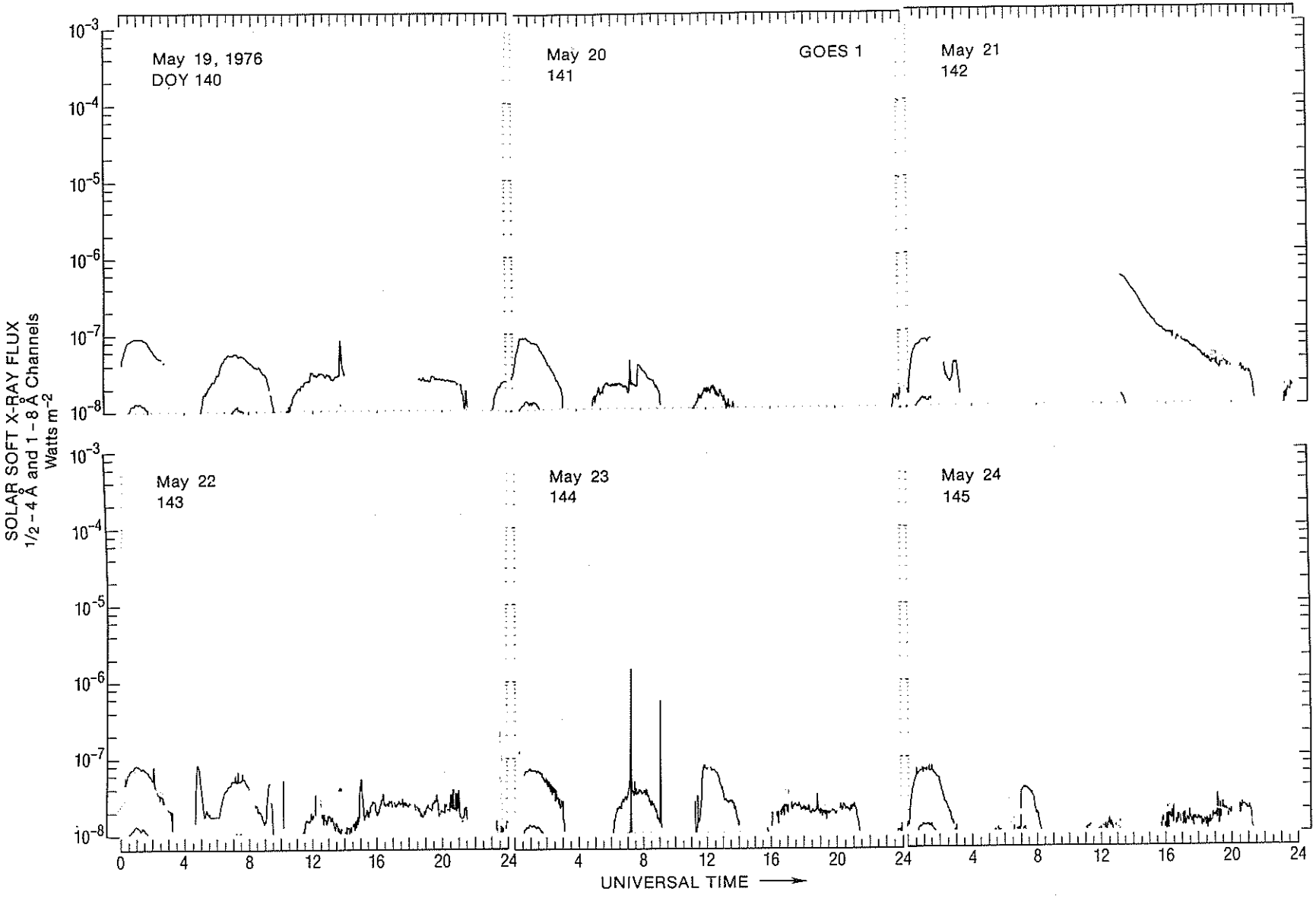


Figure 135. GOES-1 solar X-ray flux for May 19-24, 1976.

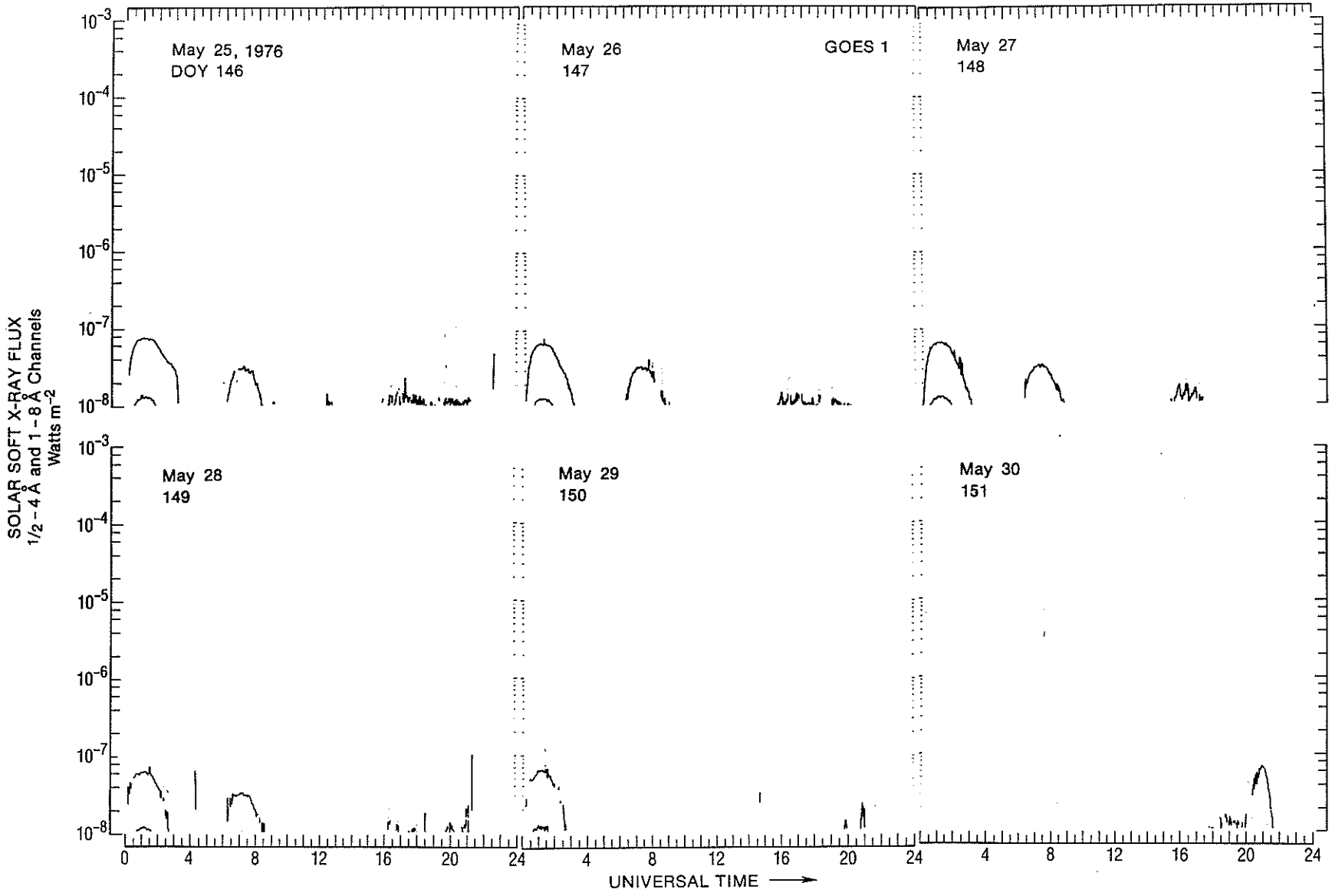


Figure 136. GOES-1 solar X-ray flux for May 25-30, 1976.

2.24 June 1976, GOES-1

2.24.1 Solar Activity Overview

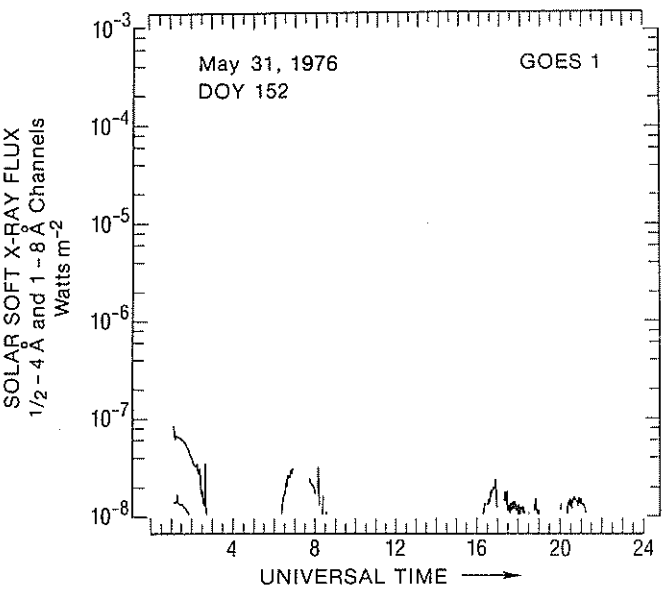


Figure 137. GOES-1 solar X-ray flux for May 31, 1976.

See figures 138-141. The solar X-ray flux was very low June 1-10, then rose to low levels for the period June 14-23, which was followed by a decline to very low flux levels June 27-30. Most of the temporal variation observed during the periods of very low flux levels, especially the diurnally recurrent structure, were probably caused by energetic magnetospheric particles and not by variations in the solar X-ray flux. On the other hand, small flare-shaped bursts were probably of solar origin. Flaring occurred from June 11-23, with the largest events being small C-class flares on June 16, 17 and 22.

2.24.2 Missing Data

GOES-1 archive solar X-ray data are missing near and during the following hours: 7 - 12 and 20 UT, June 4; 7 and 14 UT, June 5; 20 UT June 7 to 24 UT June 10; 7 - 8 UT, June 11; 10 and 14 - 15 UT, June 12; 20 - 22 UT, June 14; 3 UT, June 15; 18 UT, June 17; 21 UT June 18 to 21 UT June 19; 23 UT June 19 to 15 UT June 21; 18 UT June 21 to 02 UT June 22; 17 - 19 UT, June 22; 06 - 11 UT, June 27; 17 - 18 UT, June 19; and 23 UT, June 30. SMS-1 data did not show any evidence of significant events during these periods of missing GOES-1 data.

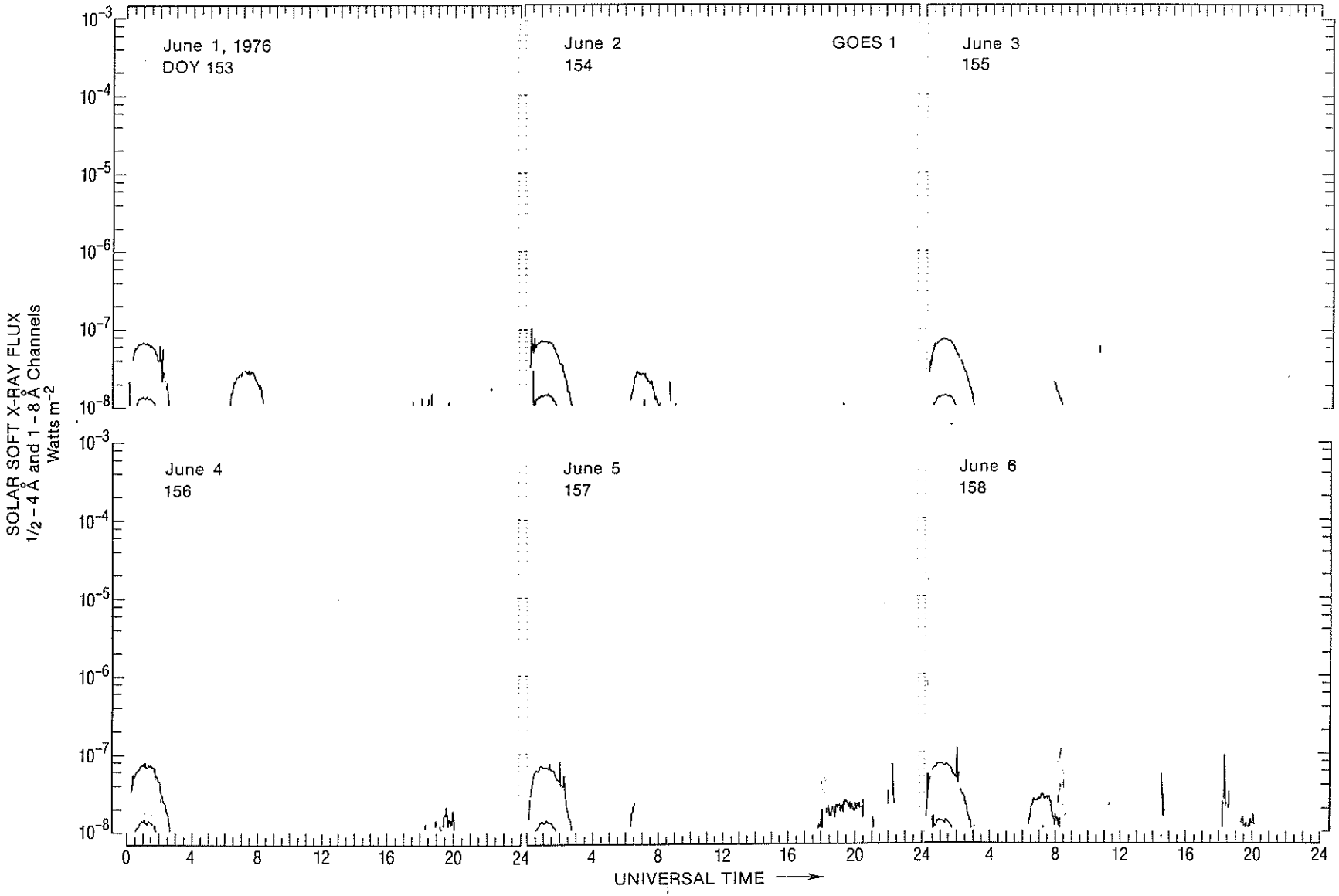


Figure 138. GOES-1 solar X-ray data for June 1-6, 1976.

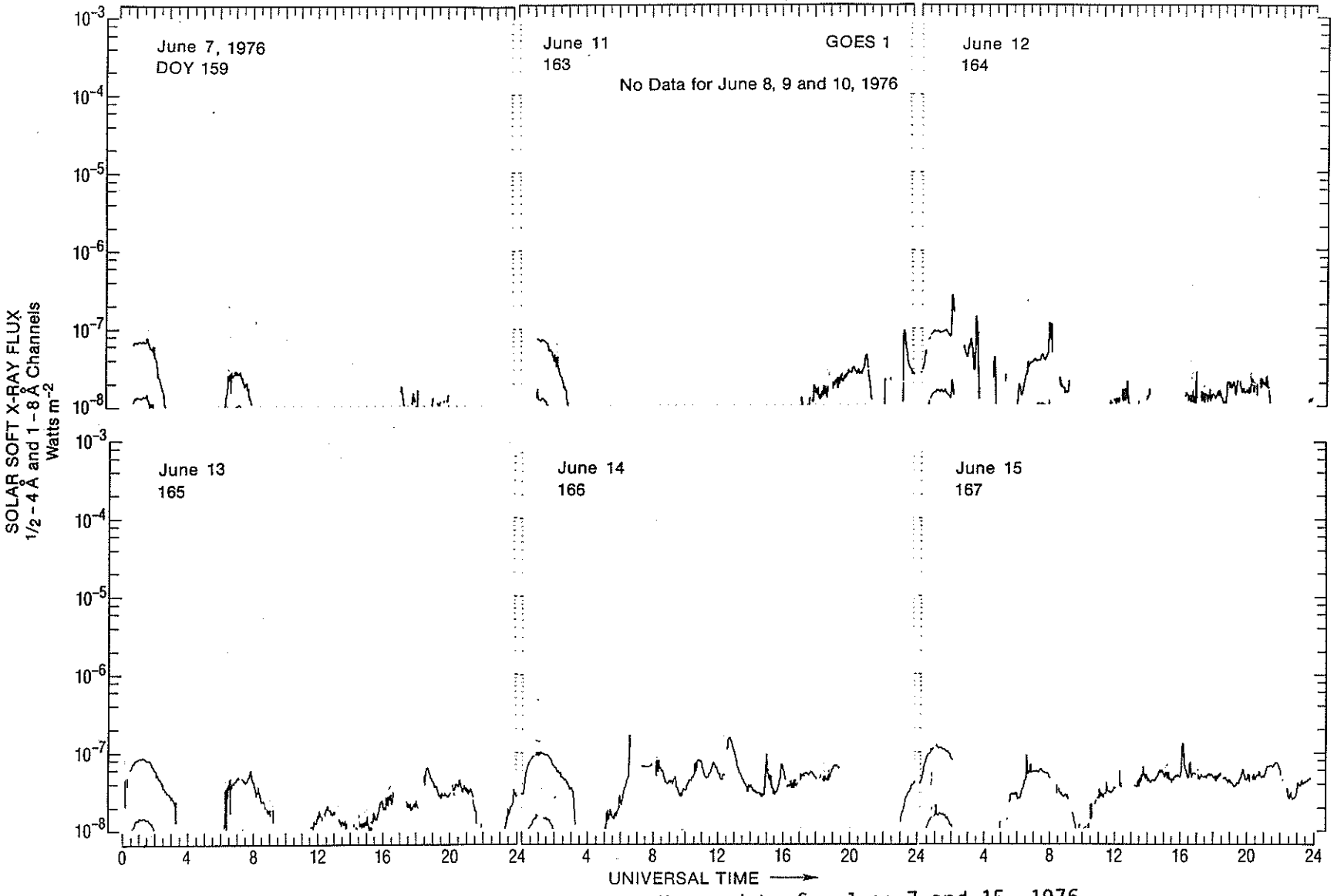


Figure 139. GOES-1 solar X-ray data for June 7 and 15, 1976. No data are available for June 8-10.

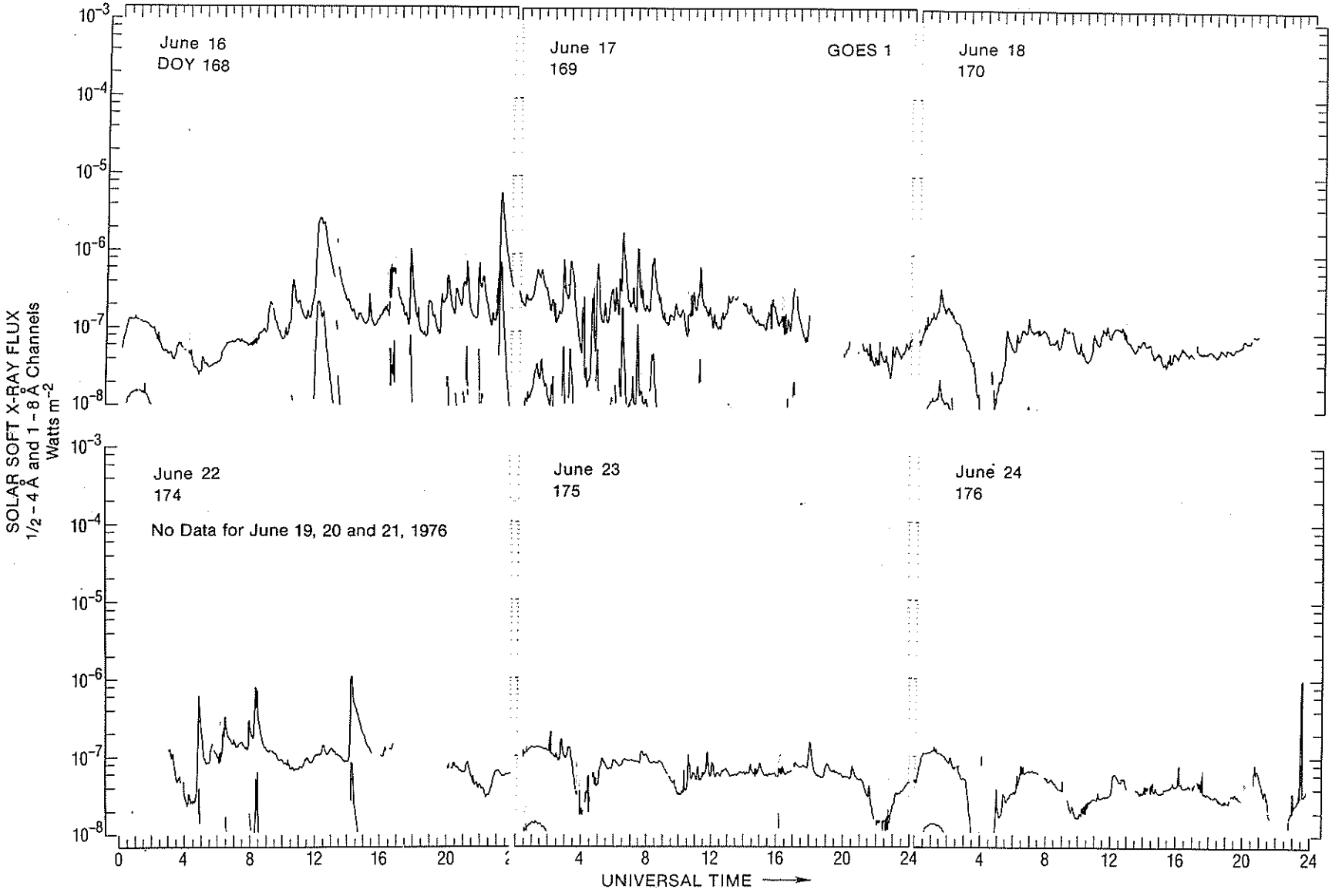


Figure 140. GOES-1 solar X-ray data for June 16-18 and 22-24, 1976. No data are available for June 19-21,1976.

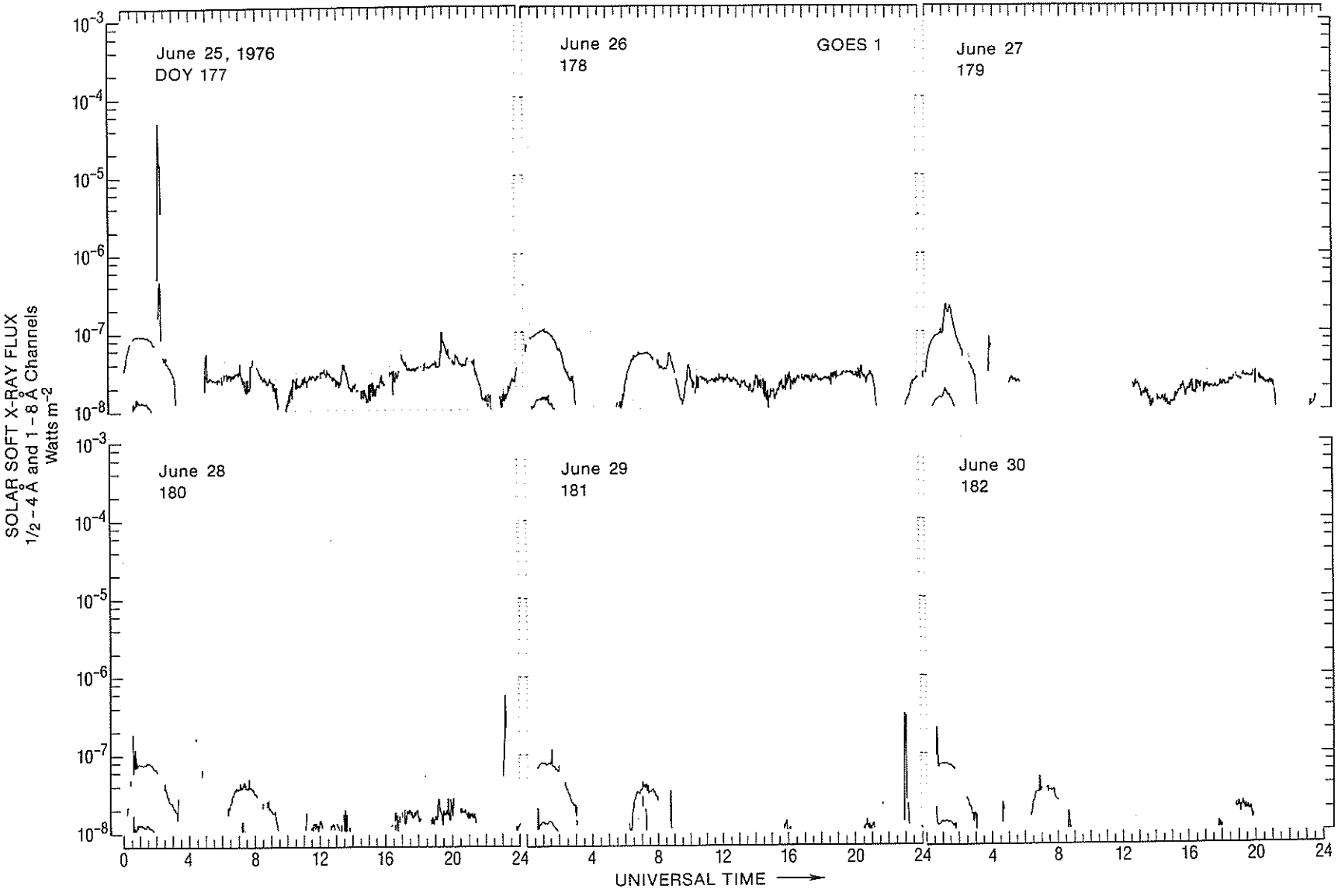


Figure 141. GOES-1 solar X-ray data for June 25-30, 1976.

2.25 July 1976, GOES-1 and SMS-1

2.25.1 Solar Activity Overview

See figures 142 and 143. The solar X-ray flux was very low all month. Most of the data shown in the figures, which tends to recur diurnally, is probably caused by detector interference from energetic magnetospheric particles rather than by true solar X-ray flux variations. No data are shown for the period July 13 - August 18 because the GOES-1 data are very low for July 13 - 16 and are missing for July 17 - August 17. SMS-1 data indicate that the solar X-ray flux was very low after July 13. SMS-1 data show a very small flare at 0801 and 1443 UT, July 31, - much smaller than C1.

2.25.2 Missing Data

GOES-1 data are missing during and near the following hours: 05 UT, July 1; 17 UT, July 4; 12 - 18 UT, July 10; 02 - 15 and 21 - 23 UT, July 13; 21 UT, July 14; 01 - 12 and 14 UT, July 15; and 15 UT July 16 to 23, July 31.

2.26 August 1976, SMS-1 and SMS-1

2.26.1 Solar Activity Overview

The solar soft X-ray flux was low throughout August except for an M2 flare at 1847 UT, August 18, and an M3 flare near 1200 UT, August 22. No SMS-2 or GOES-1 archive data are available from 0000 UT August 1 to 1736 UT August 17. Consequently no figures are shown for this period. SMS-1 data indicate that microflares (peak X-ray flux smaller than C1 or 10^{-6} Wm^{-2}) occurred at the following times: 0542, 0549, 0604, 1114, 1131, 1422, 2146, 2206, 2223 and 2257 UT, August 1; 0201 and 0208 UT, August 2; 1233 UT, August 3; 0939 UT, August 4; 1427 and 1455 UT, August 5; 2054 UT, August 12; 0039, 1153, 1217, 1235, 1453 and 1534 UT, August 16; and 2250 UT August 16. SMS-1 recorded a C1 X-ray burst at 0627 UT, August 1; a C1 burst at 0443 UT, August 6; and a C2 burst at 0200 UT, August 7. SMS-2 1-8A data during August 17 and

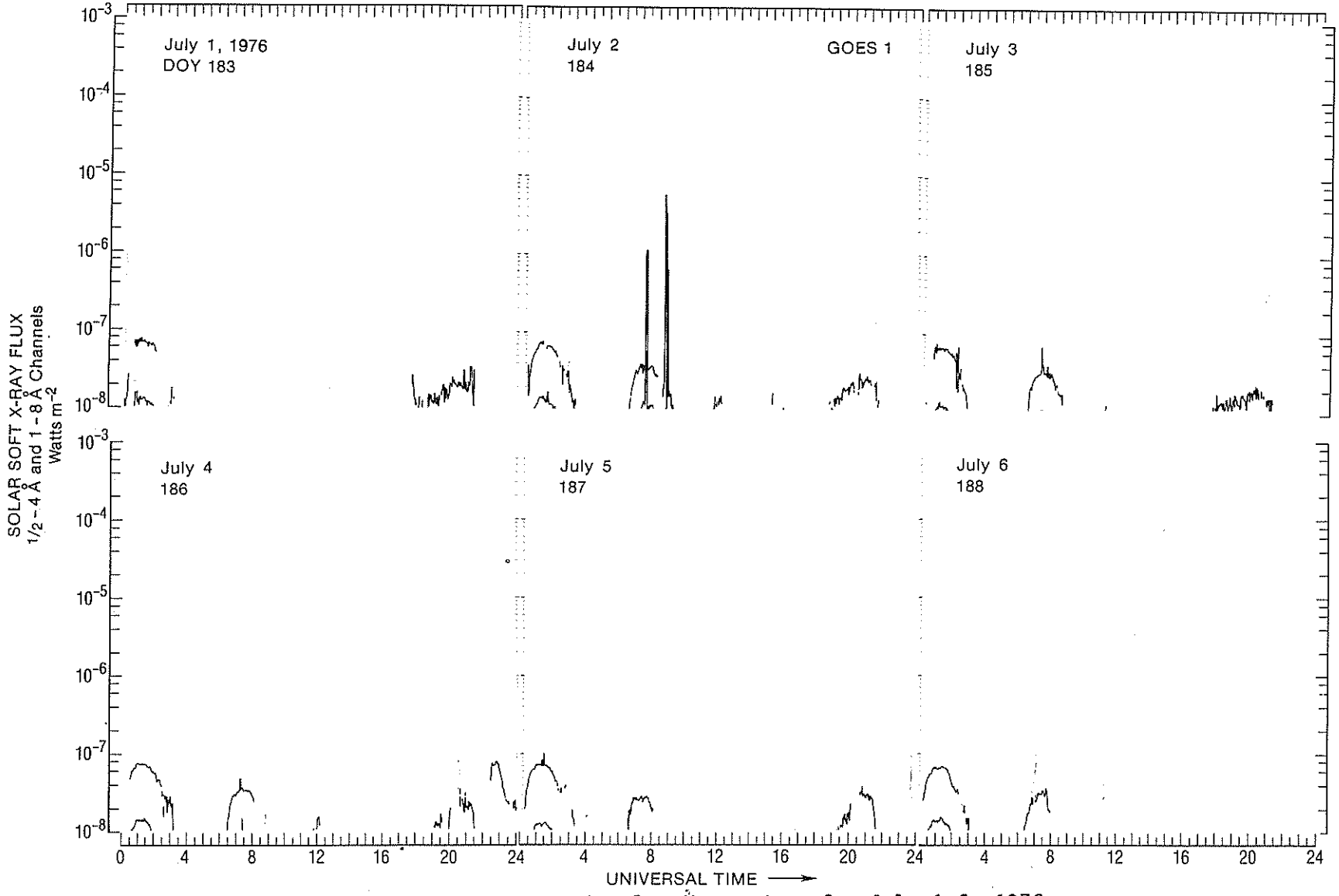


Figure 142. GOES-1 solar X-ray data for July 1-6, 1976.

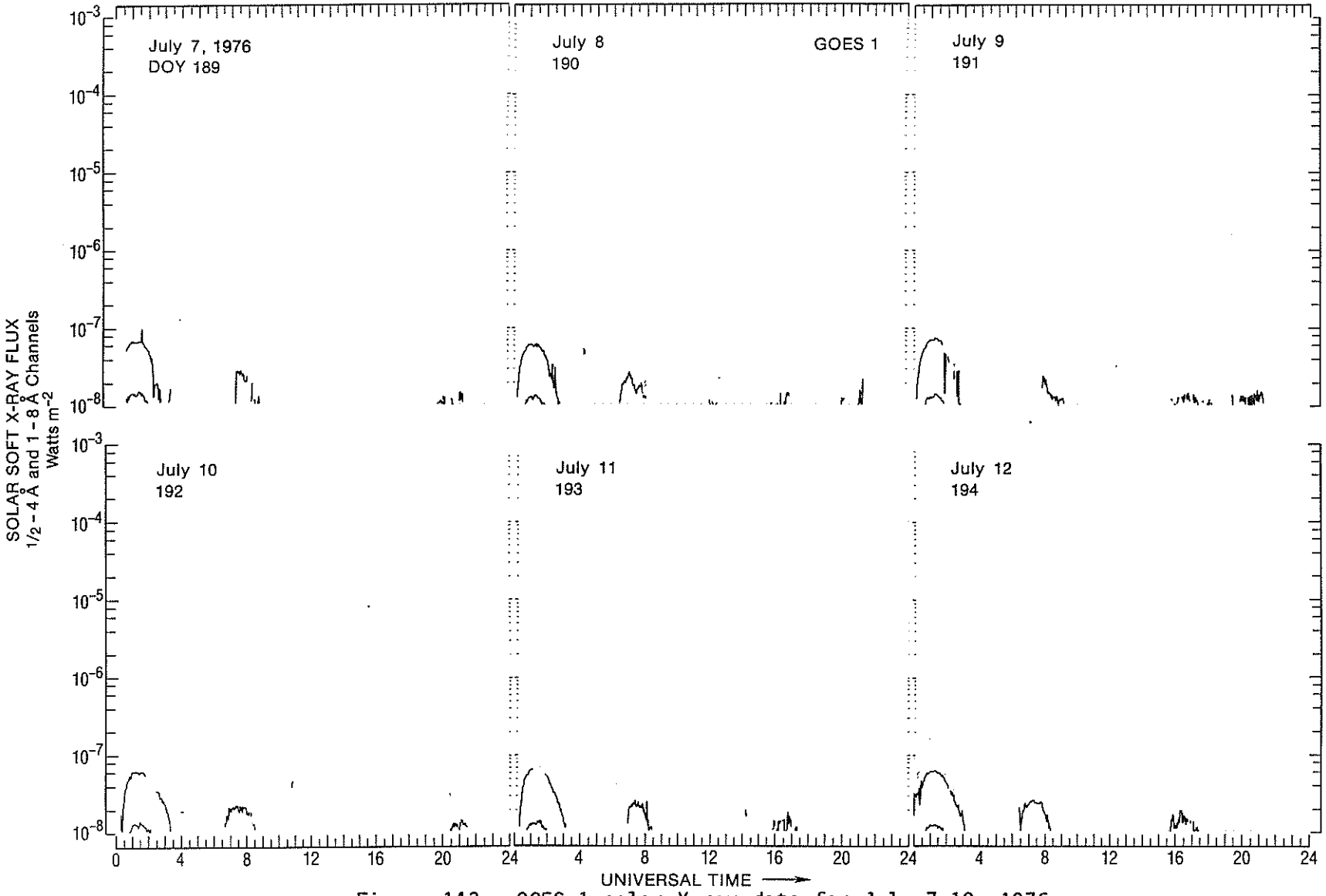


Figure 143. GOES-1 solar X-ray data for July 7-12, 1976.
(No July figures after July 12)

18 were low, about 10^{-7} Wm^{-2}, except for the M2 flare discussed above, no X-ray flares occurred with magnitude $\geq$ C1, or 10^{-6} Wm^{-2}. Note also the small flares in figure 144.

2.26.2 Missing Data

SMS-2 and GOES-1 archive X-ray data are missing before 1736 UT August 17. After that, SMS-2 data are usually available. Calibrations were usually made near 1110 and 2140 UT, daily. On August 29 and 30, SMS-2 started to enter the Earth's shadow near 0900 UT and therefore did not observe solar X-rays. Most of the time that the X-ray trace does not show in figures 144-147, the X-ray flux is below 10^{-8} Wm^{-2}. For August 19-31, the only major outage was during 1259 - 1359 UT, August 29.

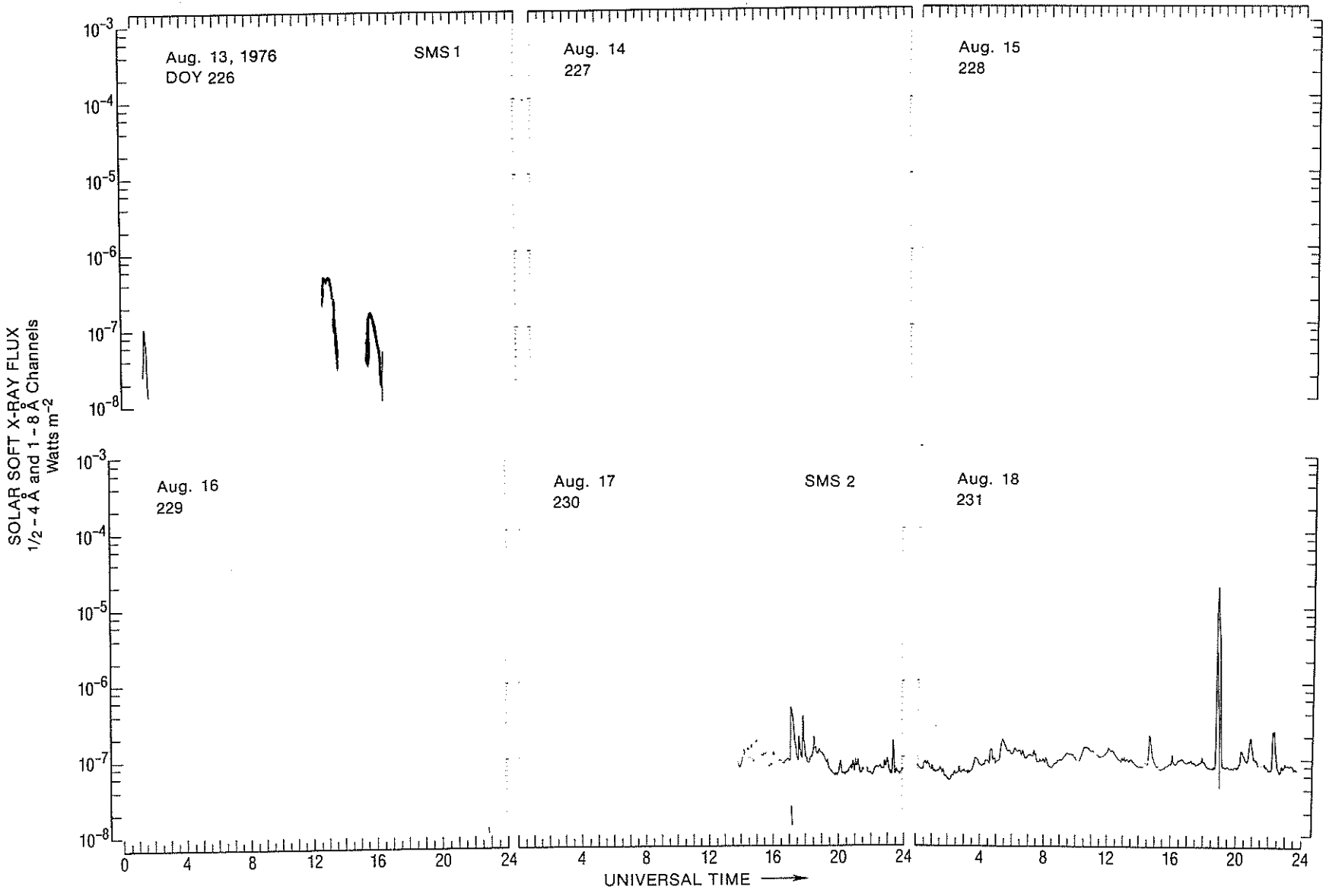


Figure 144. SMS-2 solar X-ray flux for August 13-18, 1976.

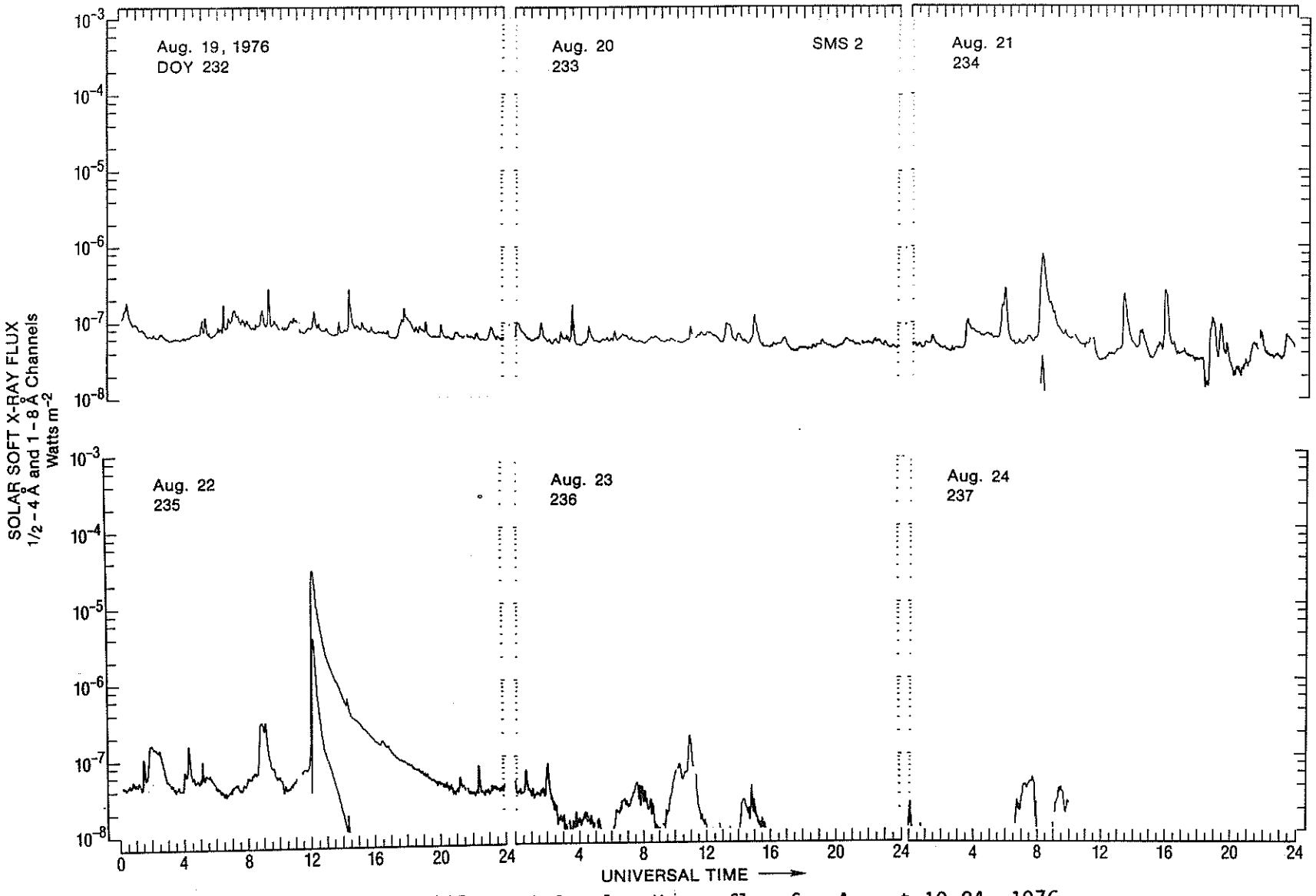


Figure 145. SMS-2 solar X-ray flux for August 19-24, 1976.

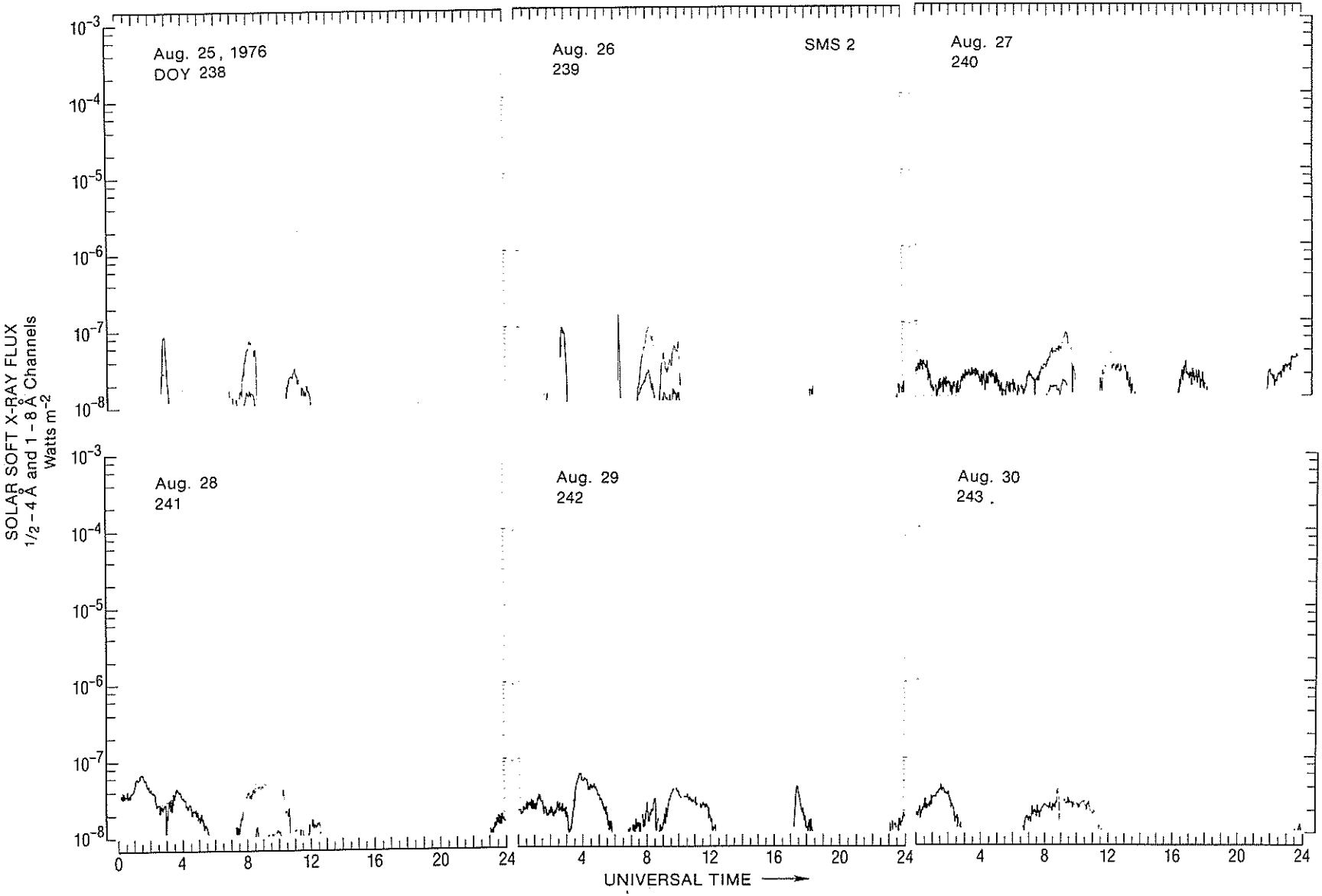


Figure 146. SMS-2 solar X-ray flux for August 25-30, 1976.

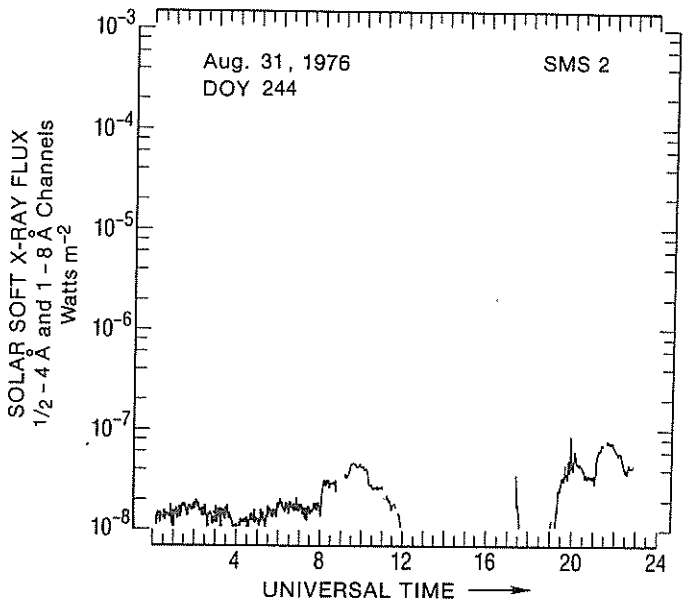


Figure 147. SMS-2 solar X-ray flux for August 31, 1976.

2.27 September 1976, SMS-2

2.27.1 Overview of Solar Activity

A small round of activity occurred at the start of the month with seven small C-class flares in figure 148, but the non-flare flux was low and decreased to very low levels late in the second half of September 5. Except for an occasional flare, the X-ray flux remained at very low levels until midday on September 9, when the flux rose to low levels with a flurry of microbursts. Two C-class flares occurred on September 17, and a C1 flare occurred on September 21. After that, the X-ray flux was at very low levels most of the time.

2.27.2 Missing Data

Calibrations were made twice daily near 1110 and 2140 UT. Usually when the X-ray curve does not show in the figures, it is because the 1-8A X-ray flux was below 10^{-8} Wm^{-2}. Data are missing for about an hour near 0900 UT daily because SMS-2 was then in the Earth's shadow. Major outages occurred

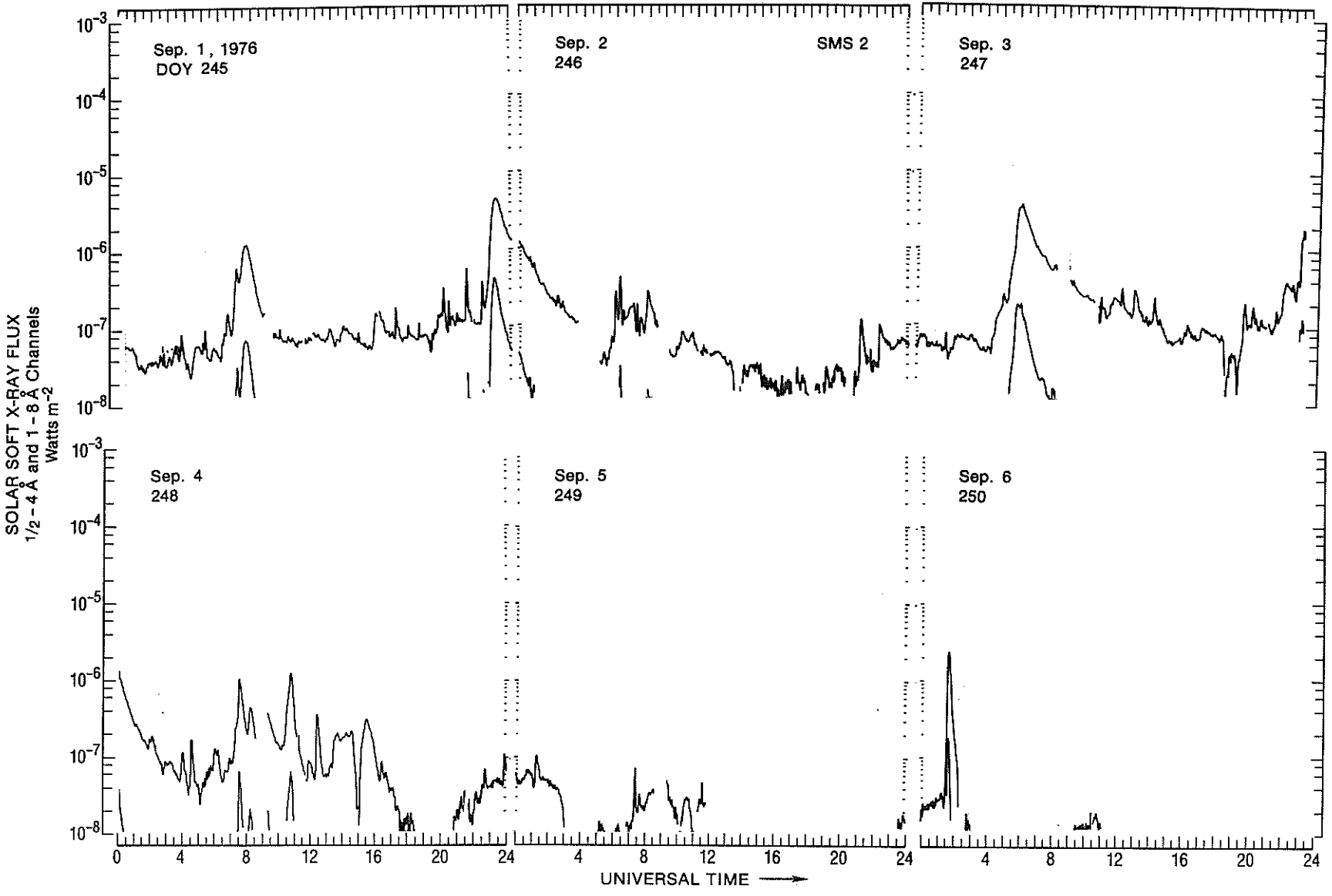


Figure 148. SMS-2 solar X-ray flux for September 1-6, 1976.

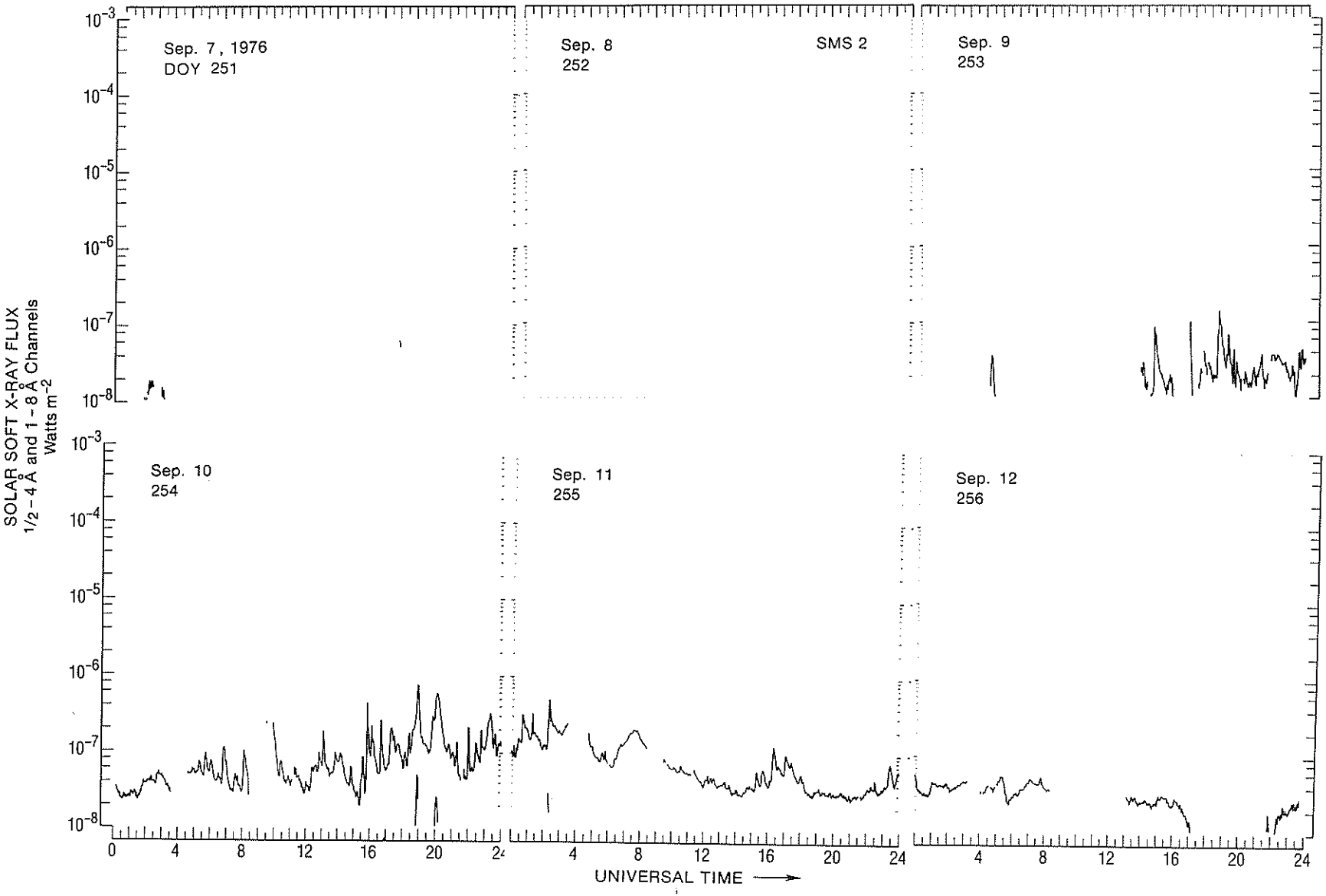


Figure 149. SMS-2 solar X-ray flux for September 7-12 1976.

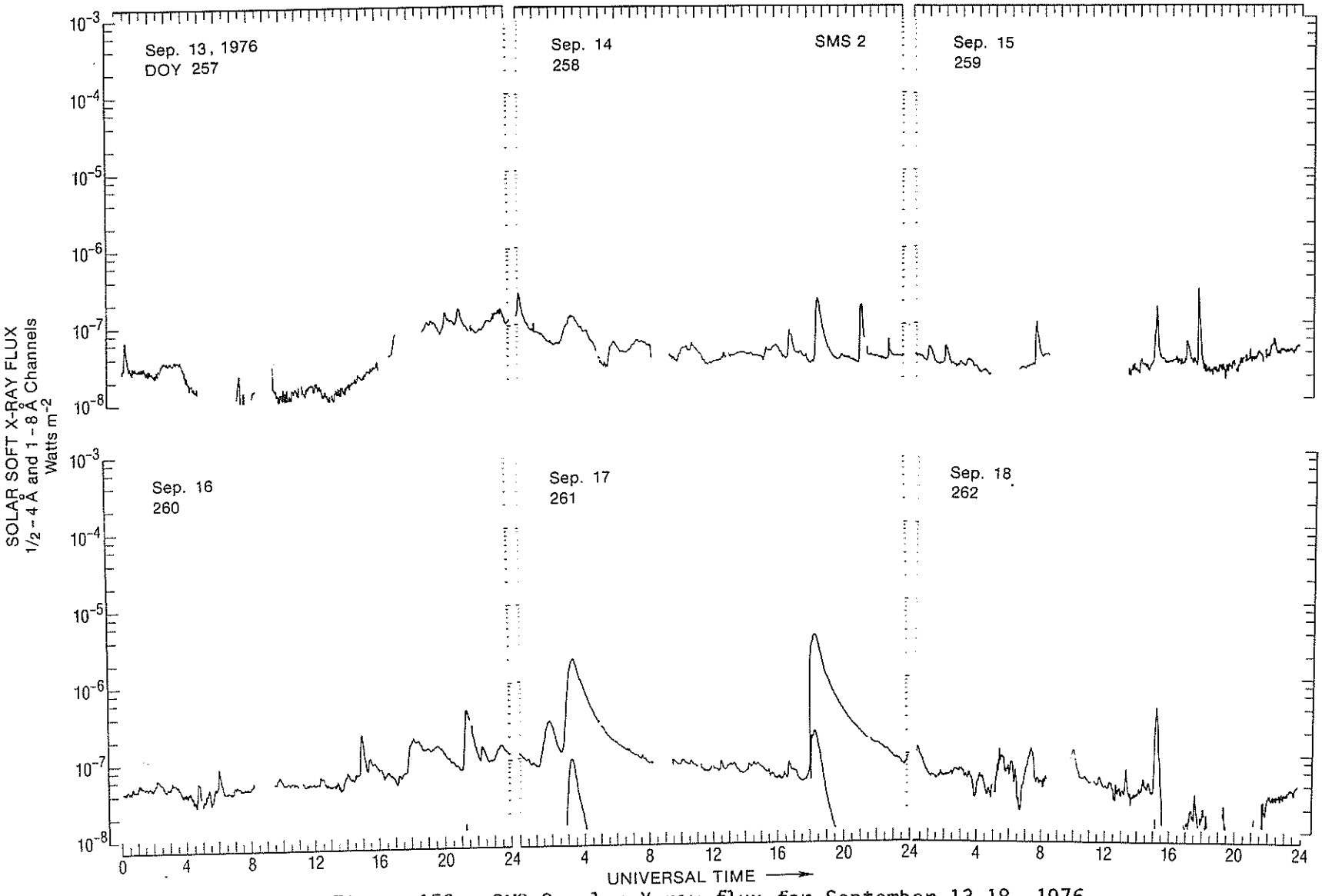


Figure 150. SMS-2 solar X-ray flux for September 13-18, 1976.

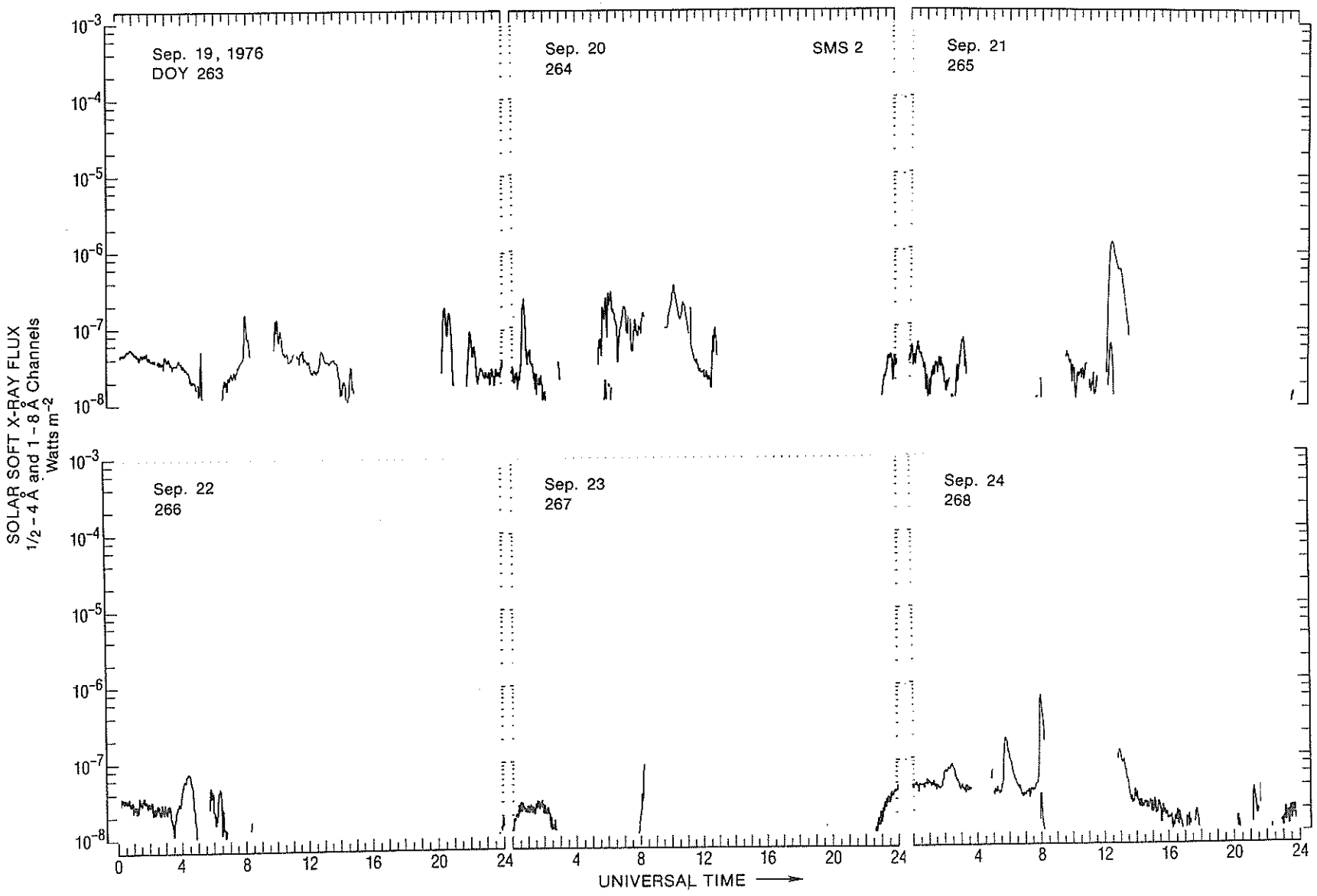


Figure 151. SMS-2 solar X-ray flux for September 19-24, 1976.

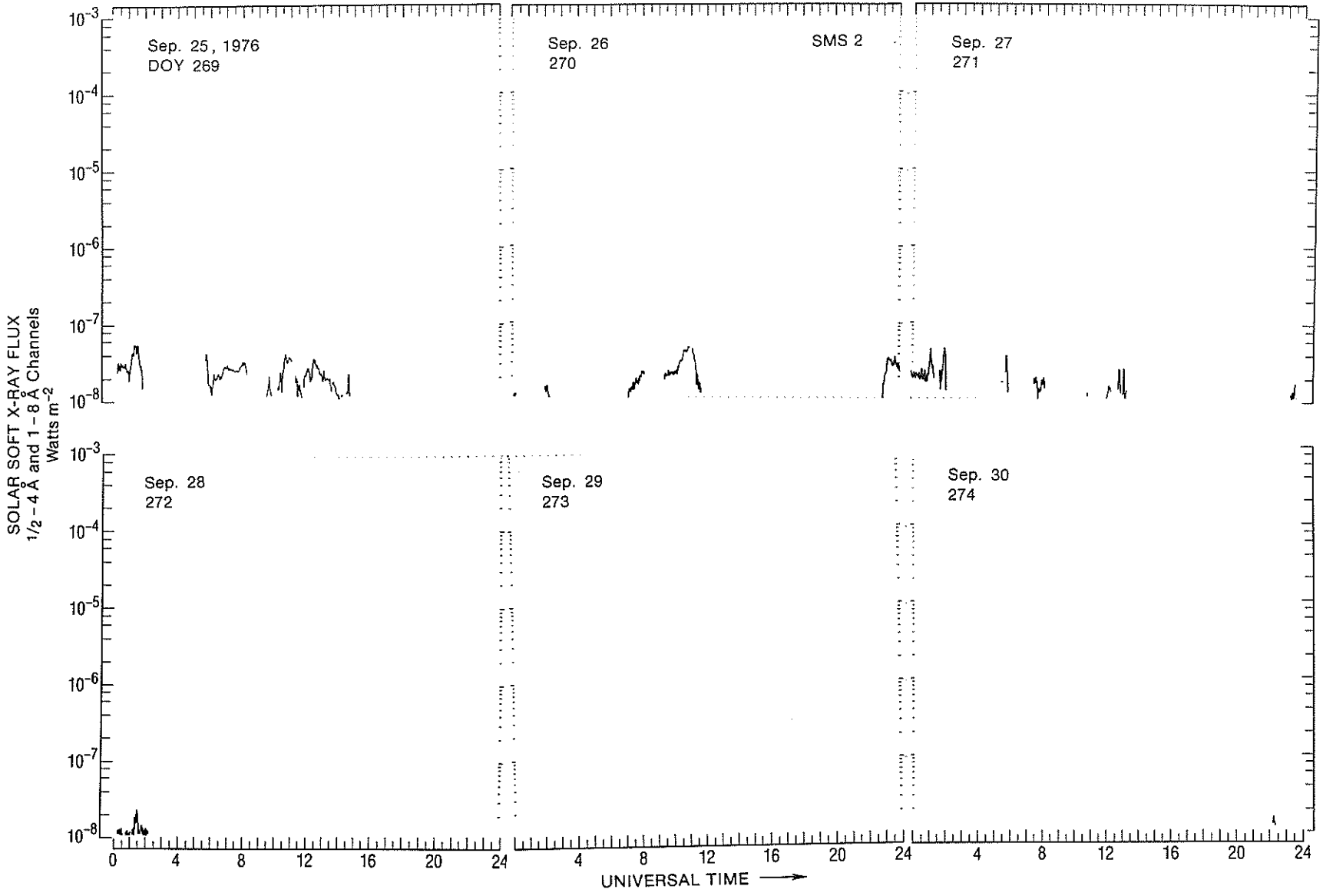


Figure 152. SMS-2 solar X-ray flux for September 25-30, 1976.

during the following periods: 0339 - 0500 UT, September 2; 1348 - 1524 UT, September 6; 0503 - 0657 and 0830 - 1219 UT, September 7; 0513 - 0706 UT, September 8; 0335 - 0436 UT, September 10; 0329 - 0445 UT, September 11; 0315 - 0404 and 0824 - 1307 UT, September 12; 1558 - 1639 and 1705 - 1843 UT, September 13; 0439 - 0626 and 0820 - 1115 UT, September 15; 0818 - 1051 and 1726 - 1805 UT, September 22; 0323 - 0429, 0818 - 1210, 1716 - 1757 and 1827 - 1925 UT, September 23; 0343 - 0454 and 0818 - 1250 UT, September 24; 0459 - 0521 UT, September 25; 0818 - 1000 UT, September 27; 0818 - 1038 UT, September 29; and 0819 - 1013 and 2300 - 2400 UT, September 30.

2.28 October 1976, SMS-2

2.28.1 Overview of Solar Activity

The solar X-ray flux was very low in figures 153 and 154, and low during October 14-17, 19-22, and 26-31, in figures 155, 156, 157 and 158. The high-point of the month was the small C-class burst on October 28. Overall, October was a quiet low-flux month.

2.28.2 Missing Data

Calibrations were at about 1110 and 2140 UT daily. SMS-2 was in the Earth's shadow for more than an hour at the beginning of the month, diminishing to no shadow-effect starting on October 15. Major outages in SMS-2 archive X-ray data occurred during the following periods: 0500 - 0533 UT, October 1; 0755 - 1115 UT, October 5; 0822 - 1240 UT, October 6; 0824 - 1309 UT, October 8; 1715 - 1910 UT, October 15; 2241 UT October 17 to 1715 UT October 18; 1554 October 22 to 2256 UT October 25; 1458 - 1647 UT, October 27; and 2300 - 2400 UT, October 31.

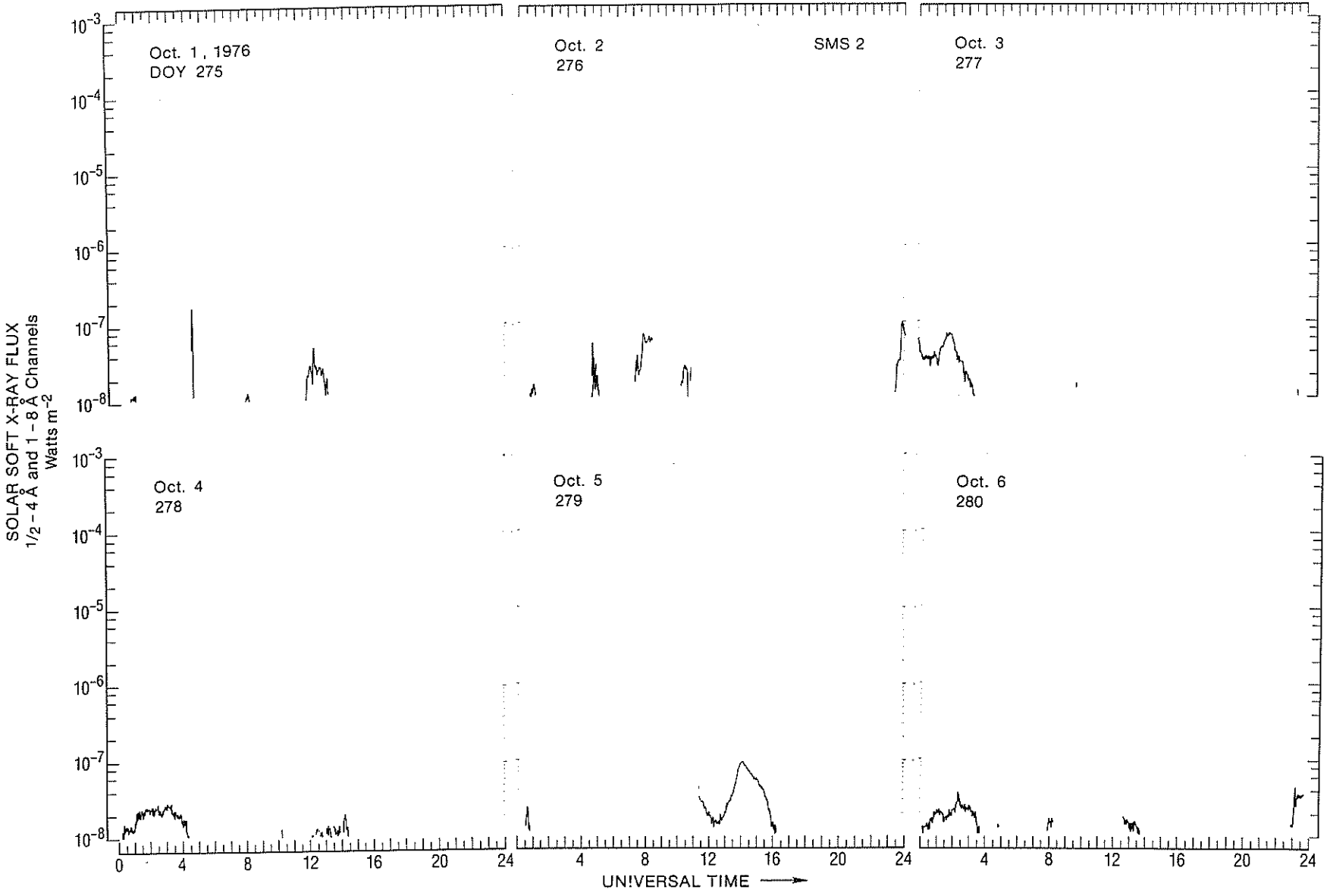


Figure 153. SMS-2 solar X-ray flux for October 1-6, 1976.

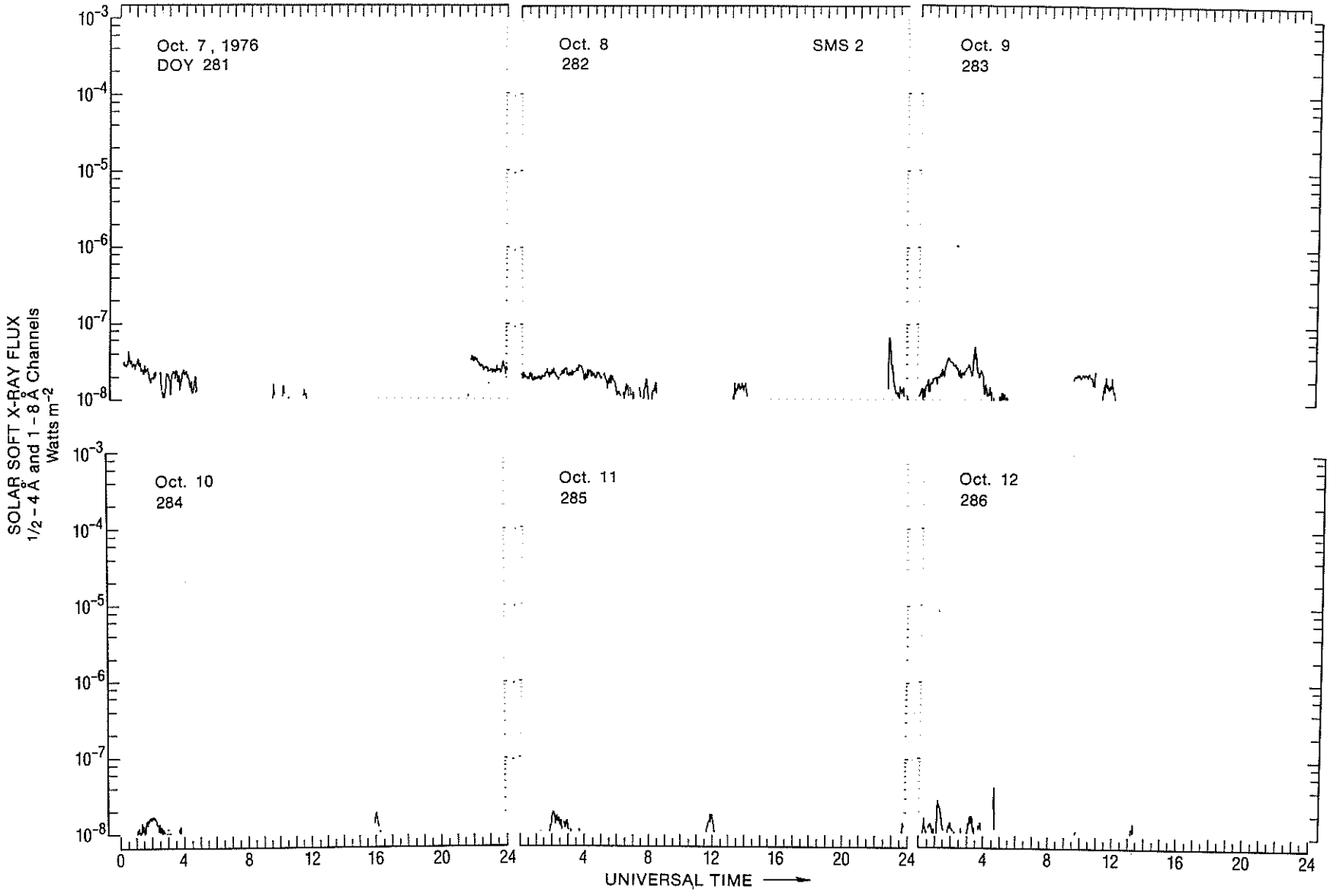


Figure 154. SMS-2 solar X-ray flux for October 7-12, 1976.

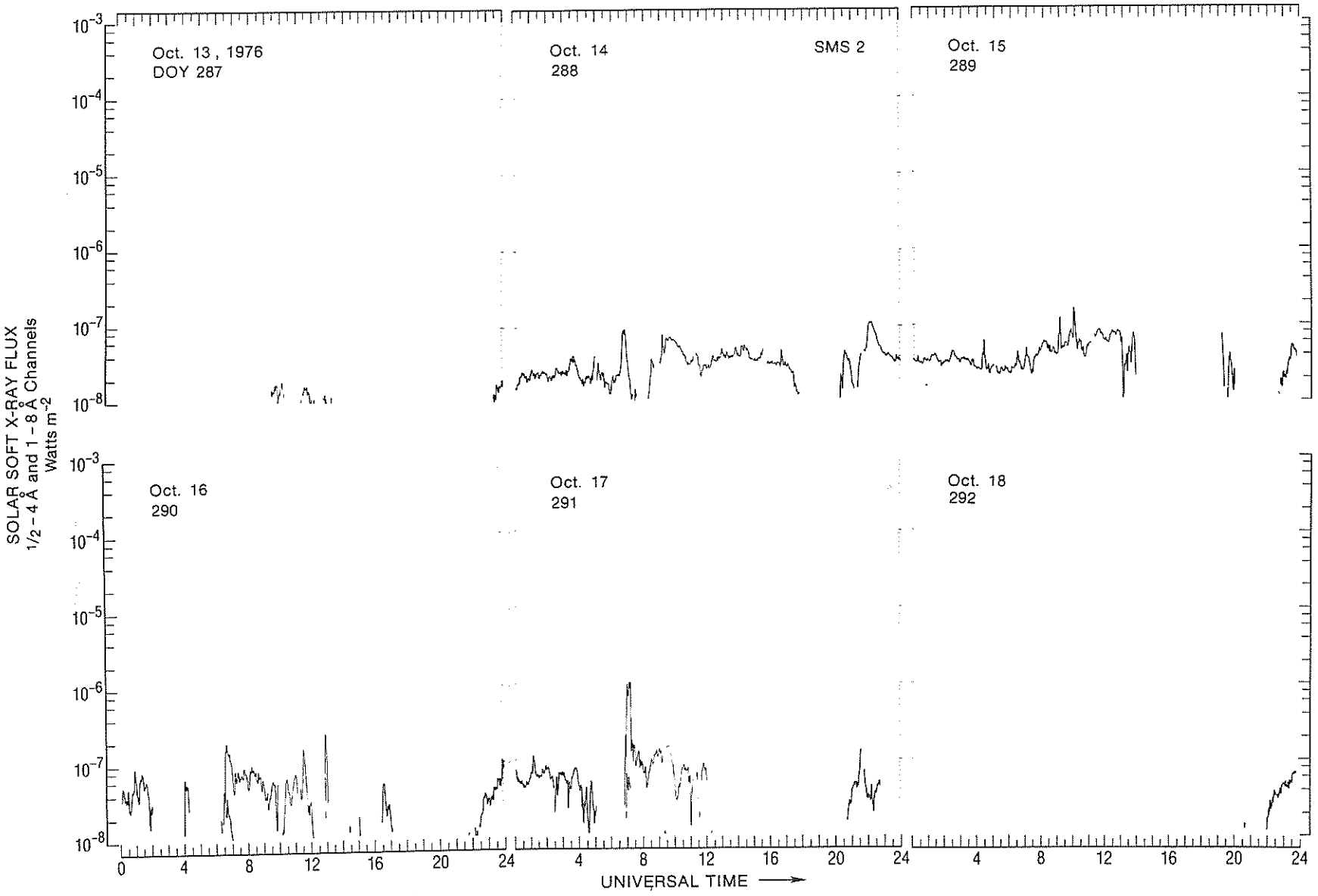


Figure 155. SMS-2 solar X-ray flux for October 13-18, 1976.

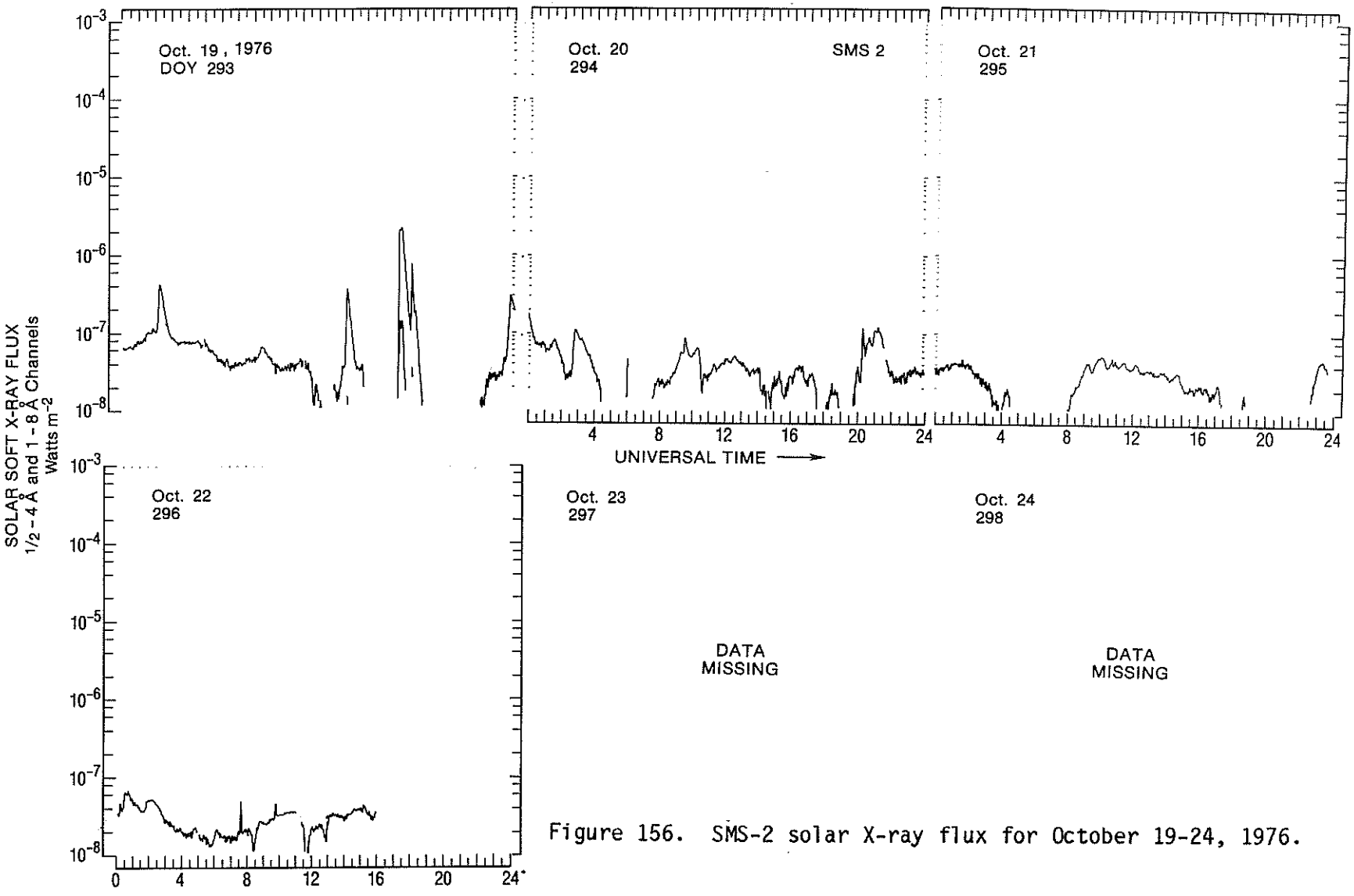


Figure 156. SMS-2 solar X-ray flux for October 19-24, 1976.

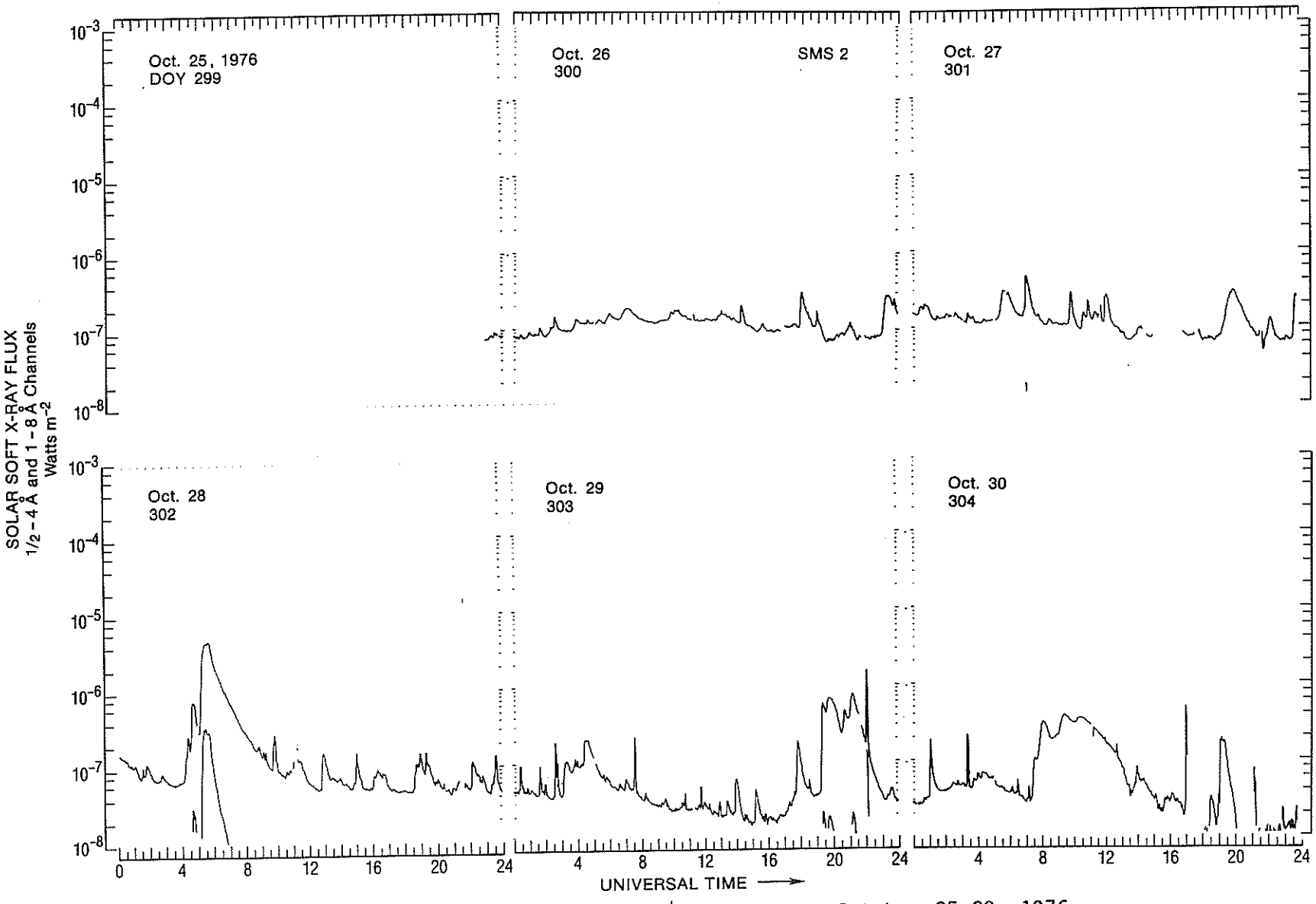


Figure 157. SMS-2 solar X-ray flux for October 25-30, 1976.

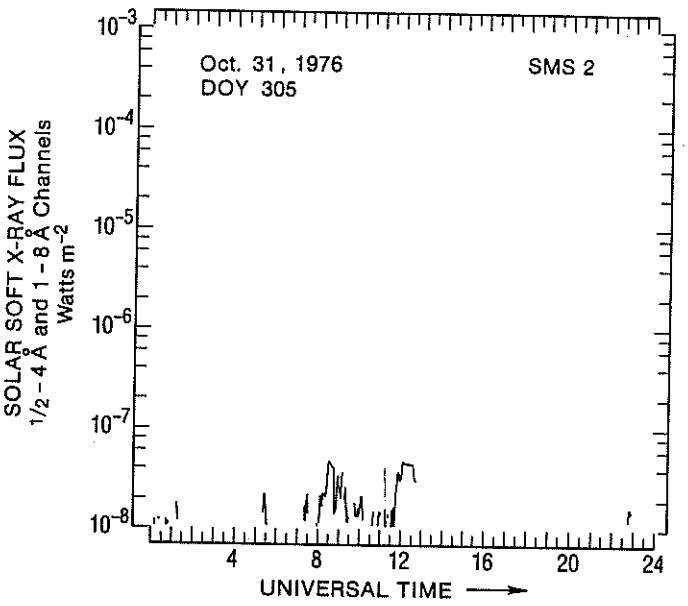


Figure 158. SMS-2 solar X-ray flux for October 31, 1976.

2.29 November 1976, SMS-2

2.29.1 Solar Activity Overview

See figures 159-163. Except for the small long lasting flare on November 1, the solar X-ray flux was very low during the period November 1-16. It rose on November 17 to low levels on November 18-19 and then decreased again to very low levels for the period November 23-30. All the solar flares observed by SMS-2 were smaller than C1, or 10^{-6} Wm^{-2}.

2.29.2 Missing Data

Calibrations were near 1110 and 2140 UT daily. Most of time when the X-ray curve does not show in the figures, the 1-8 Å X-ray flux was below 10^{-8} Wm^{-2}. Major archive data outages occurred during the following periods: 1441 - 1512 UT, November 2; 0924 - 1143 UT, November 12; 2210 - 2258 UT, November 15; 1308 - 1349 UT, November 19; 1901 - 2048 UT, November 21; 0448 - 0528 UT, November 24; and 2300 - 2400 UT, November 30.

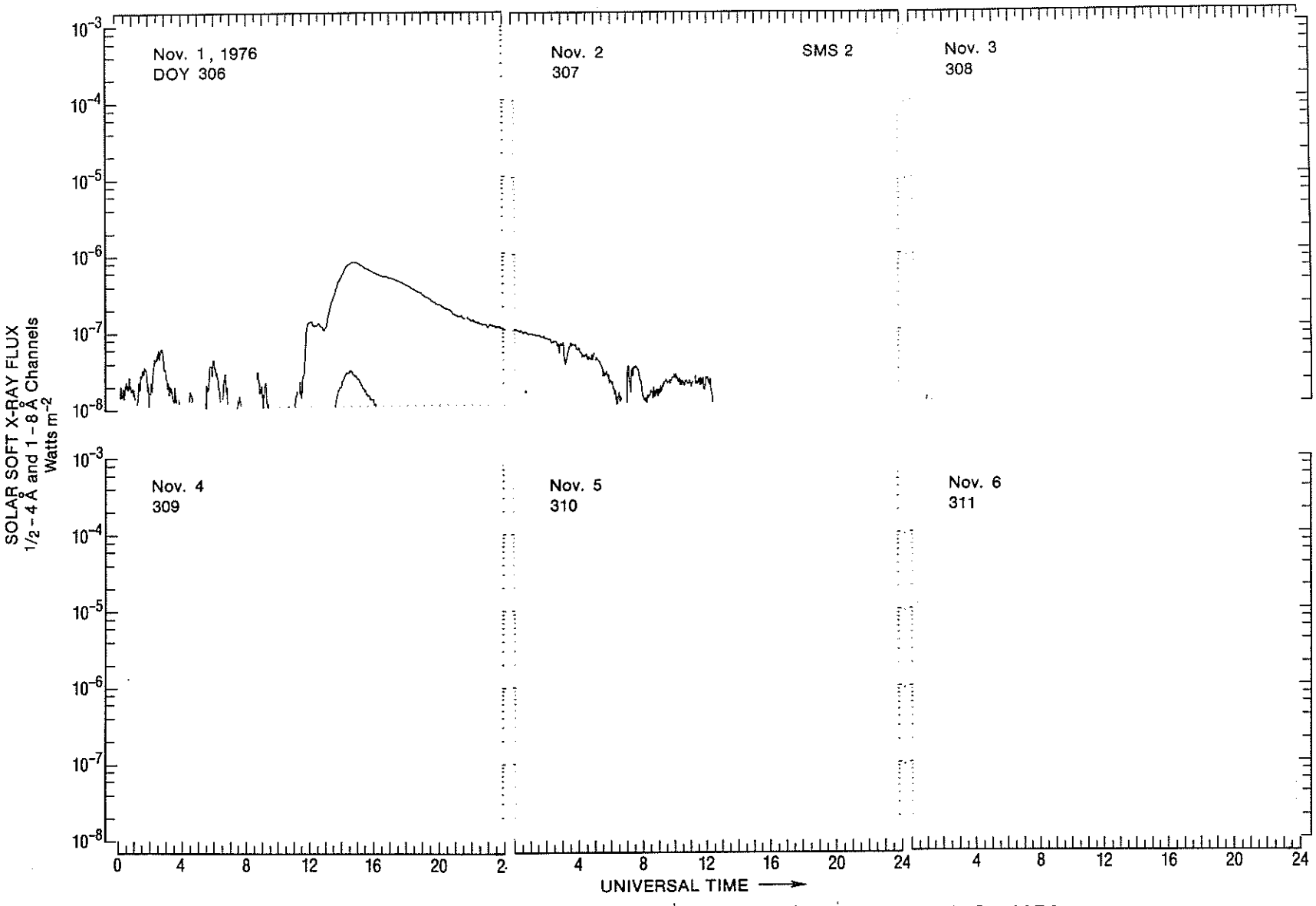


Figure 159. SMS-2 solar X-ray flux for November 1-6, 1976.

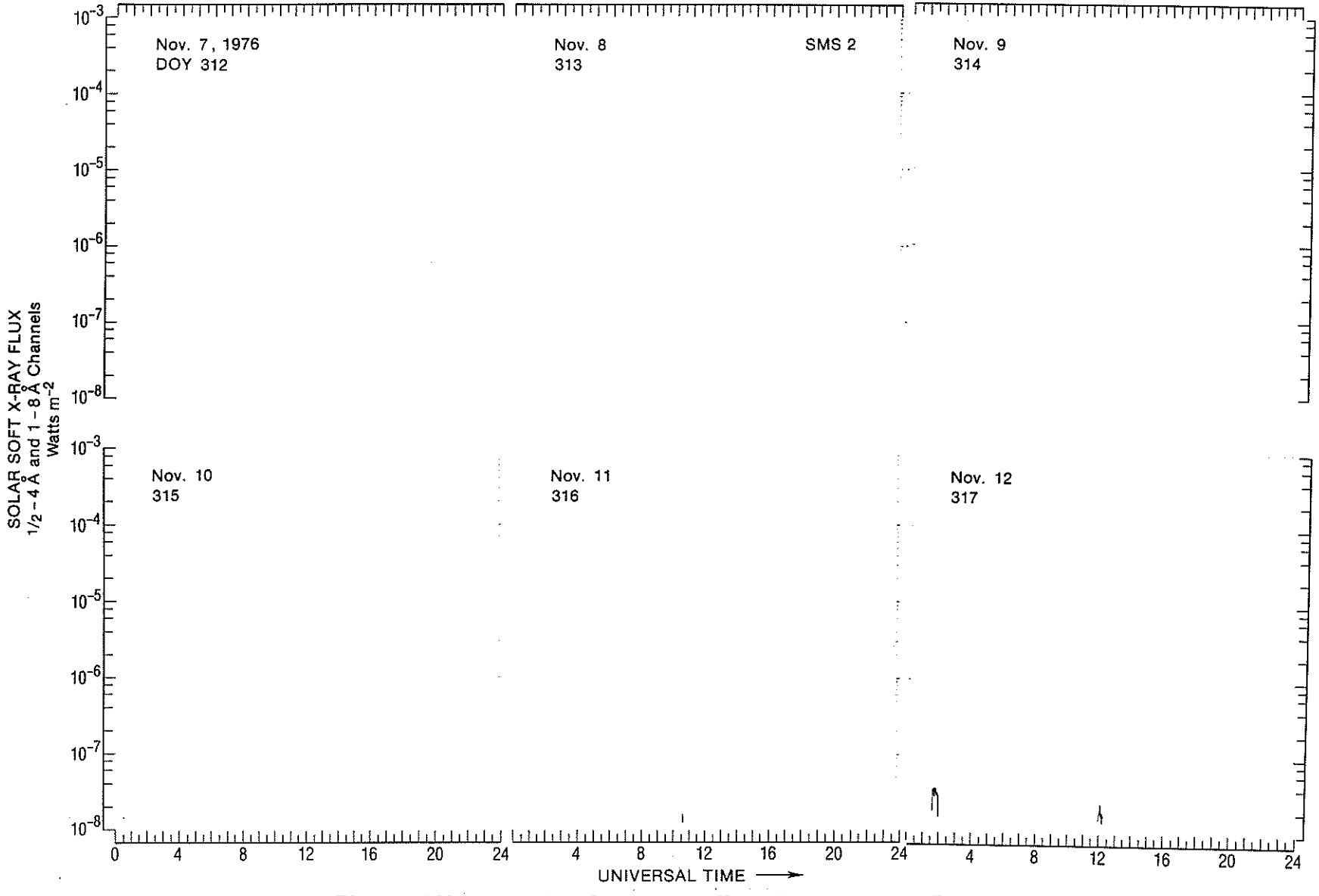


Figure 160. SMS-2 solar X-ray flux for November 7-12, 1976.

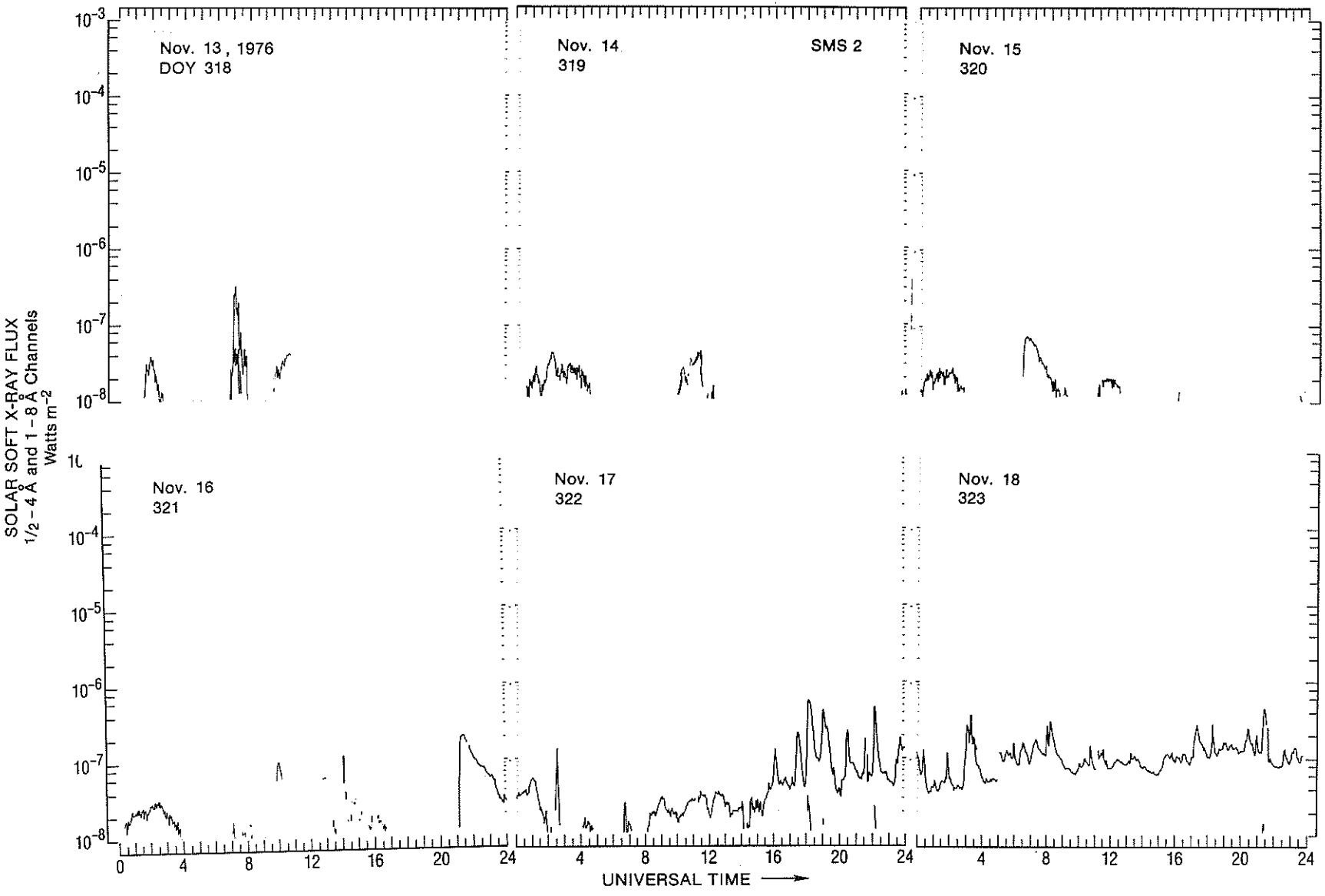


Figure 161. SMS-2 solar X-ray flux for November 13-18, 1976.

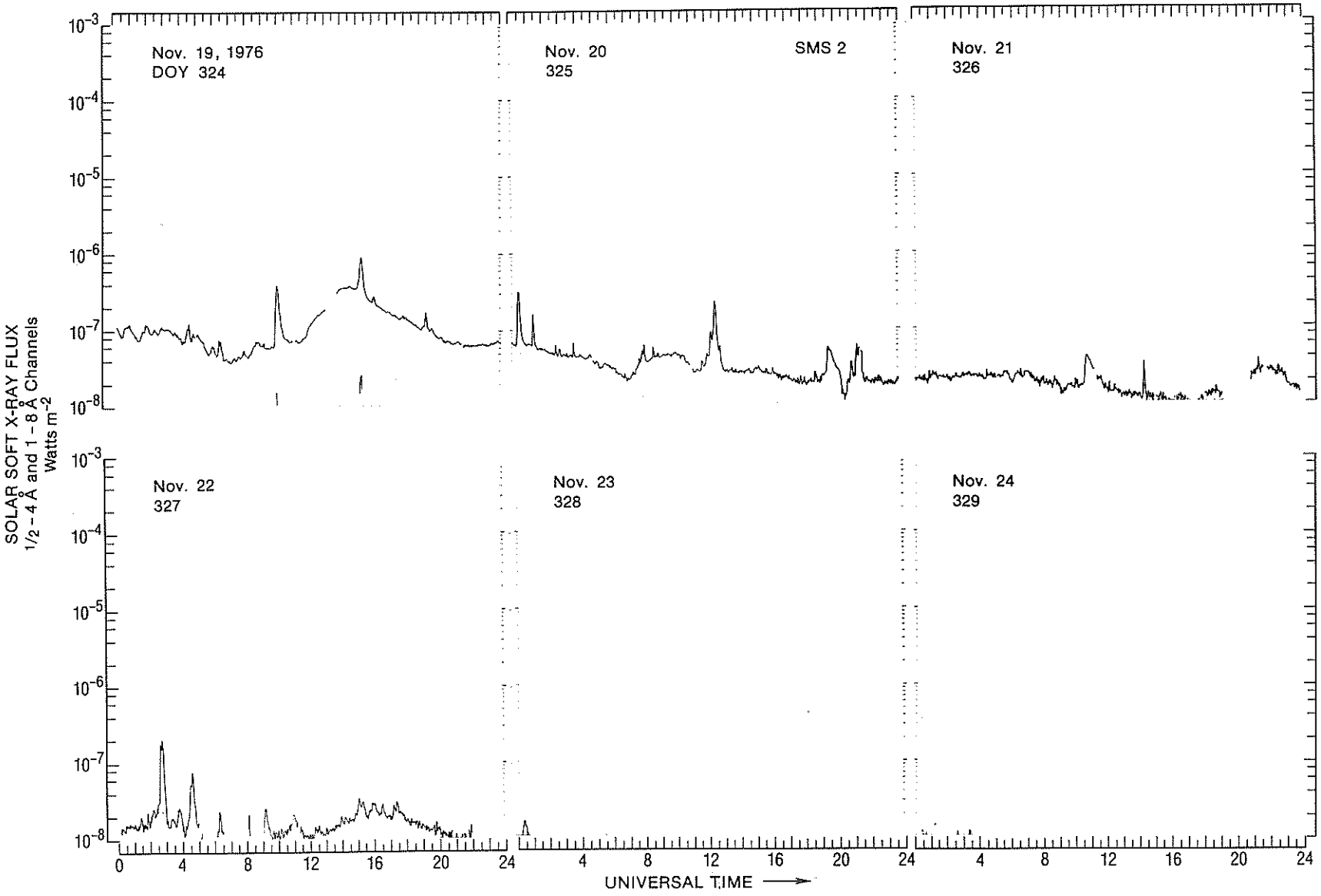


Figure 162. SMS-2 solar X-ray flux for November 19-24, 1976.

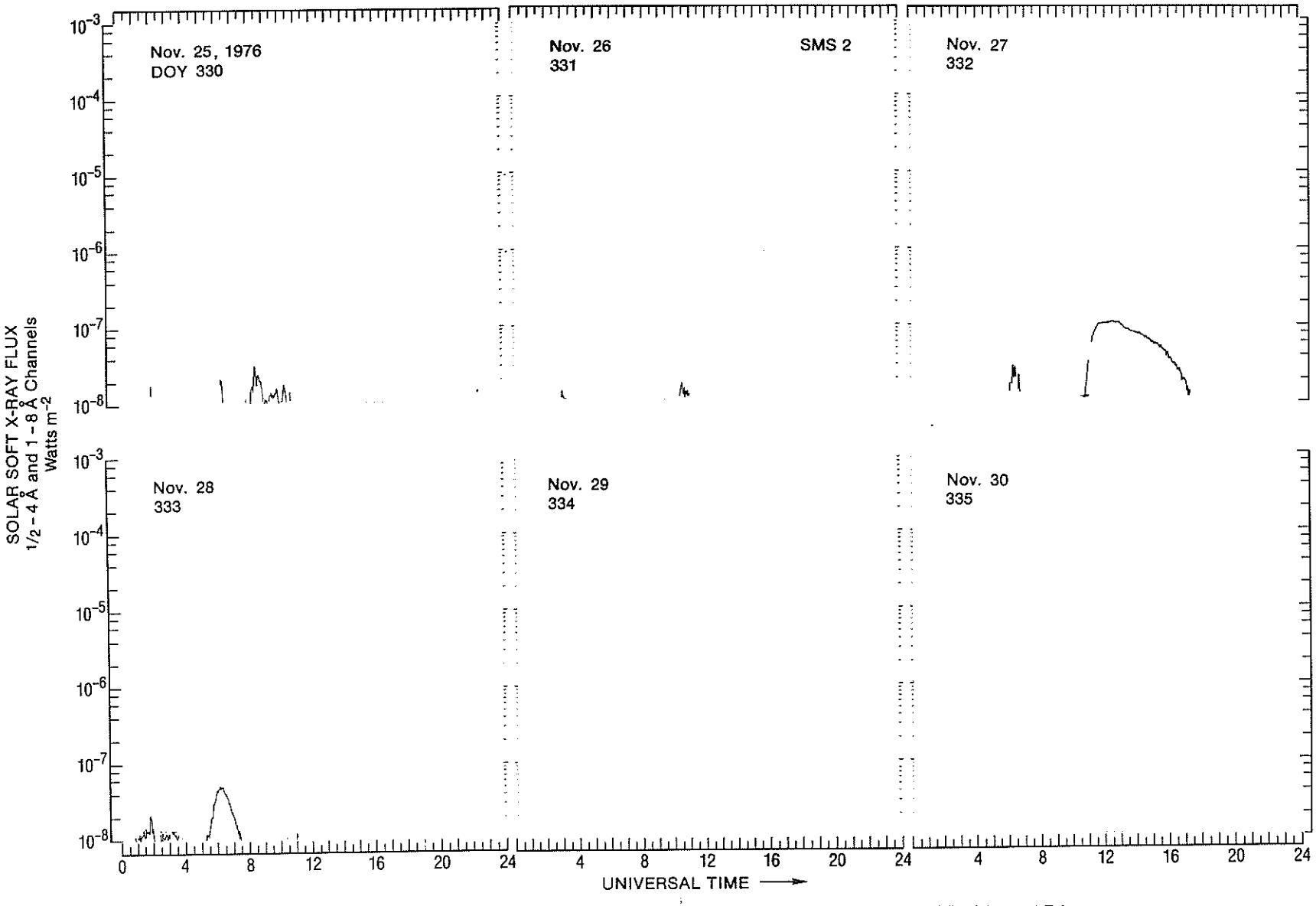


Figure 163. SMS-2 solar X-ray flux for November 25-30, 1976.

2.30 December 1976, SMS-2

2.30.1 Solar Activity Overview

The solar X-ray flux continued from the end of November at very low flux levels through December 7. During December 8-13, frequent microbursts occurred (also a C1 spike occurred on December 9).

The nonflare background flux rose to low levels for the period December 14-19, and about one small C class ($\geq 10^{-7}$ Wm^{-2}) flare per day occurred. The X-ray flux then dropped again to very low levels for December 20-21. The solar X-ray activity rose again to low levels on December 22 through the end of December. Note the four C-class flares on December 24 and the C X-ray bursts on December 28, 30 and 31.

2.30.2 Missing Data

Calibrations continued at 1110 and 2140 UT daily. Most of the time when no X-ray trace shows in the figures, the X-ray flux is below 10^{-8} Wm^{-2}. Major outages of the archived SMS-2 X-ray data occurred during the following periods: 0459 - 0749 UT, December 1; 0256 - 0328 and 0459 - 0541 UT, December 6; 0340 - 0421 and 0426 - 0624 UT, December 9; 0220 - 0312 and 1132 - 1452 UT, December 10; 2230 - 2346 UT, December 11; 1916 UT December 20 to 0203 UT December 21; 1436 - 2153 UT, December 21; 0357 - 1238 UT, December 26; 2354 UT December 26 to 1411 UT December 27; and 2300 - 2400 UT, December 31.

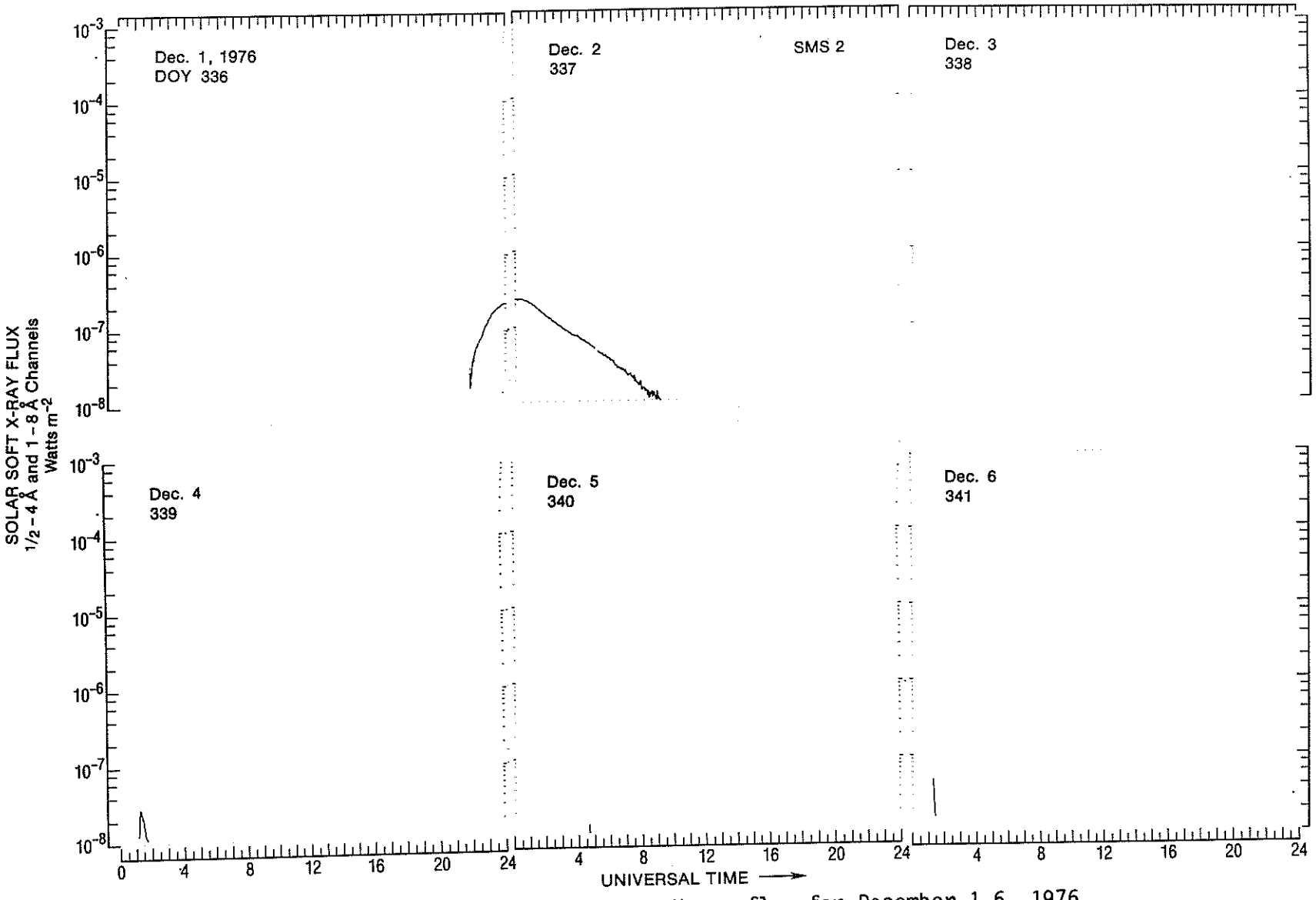


Figure 164. SMS-2 solar X-ray flux for December 1-6, 1976.

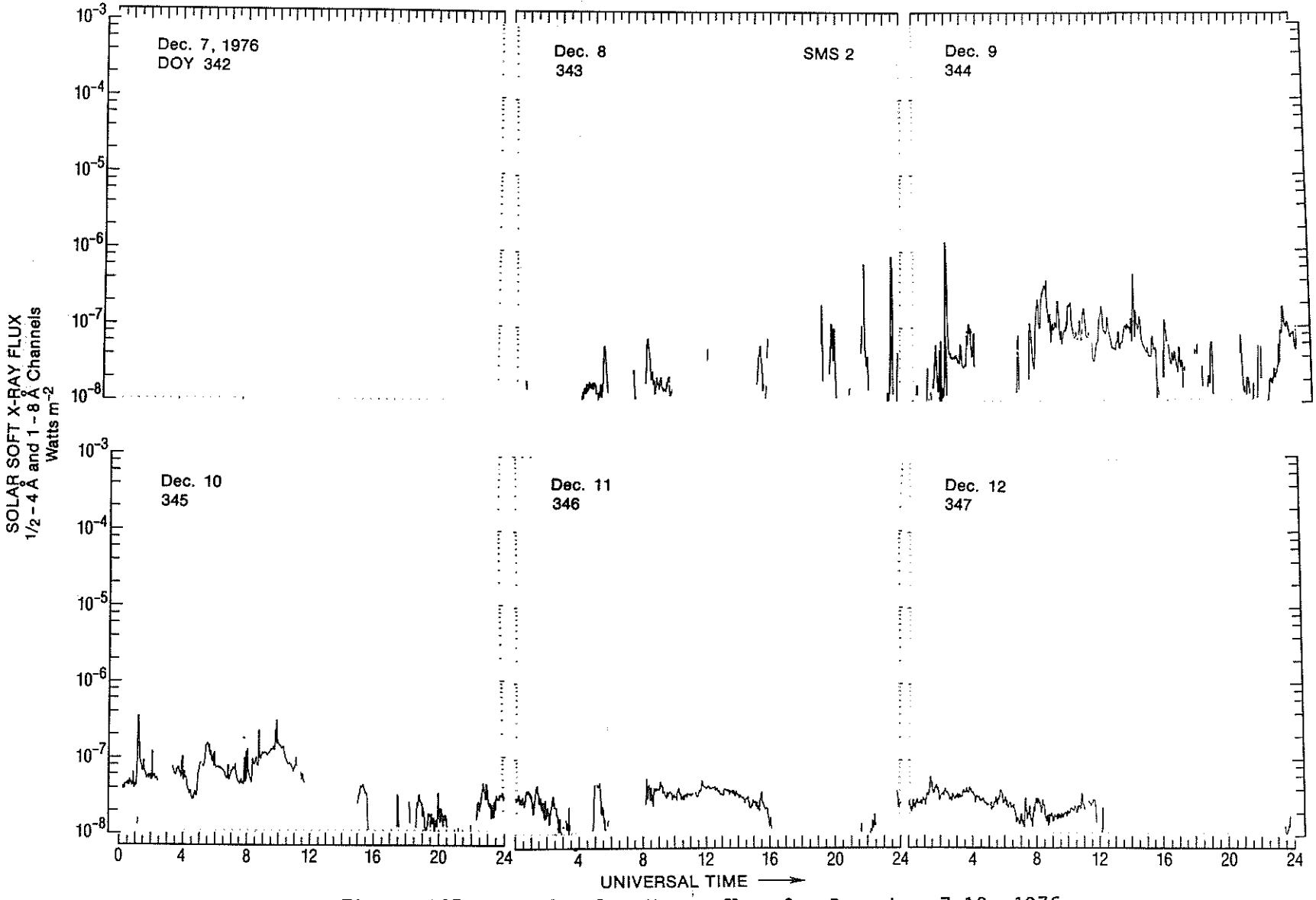


Figure 165. SMS-2 solar X-ray flux for December 7-12, 1976.

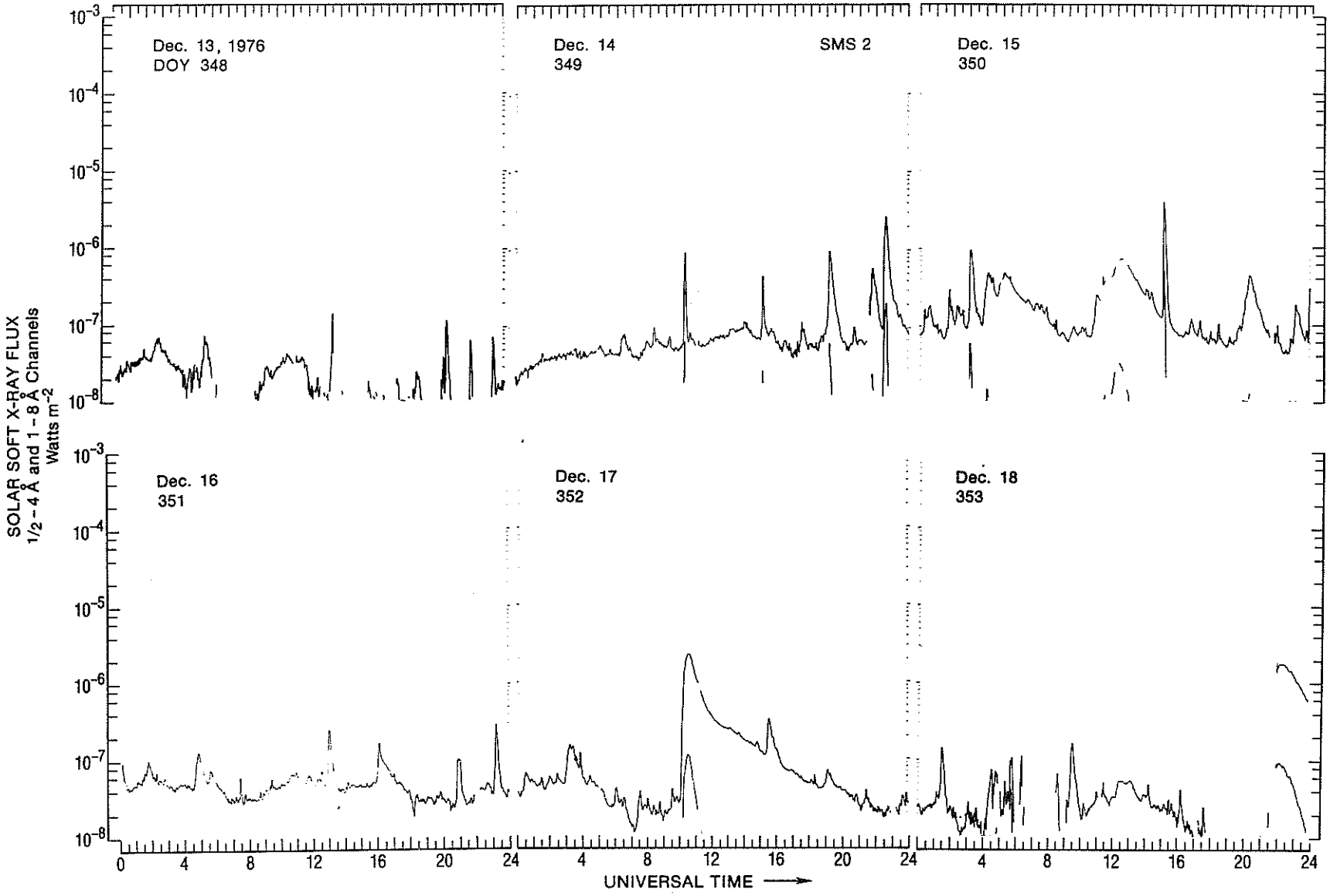


Figure 166. SMS-2 solar X-ray flux for December 13-18, 1976.

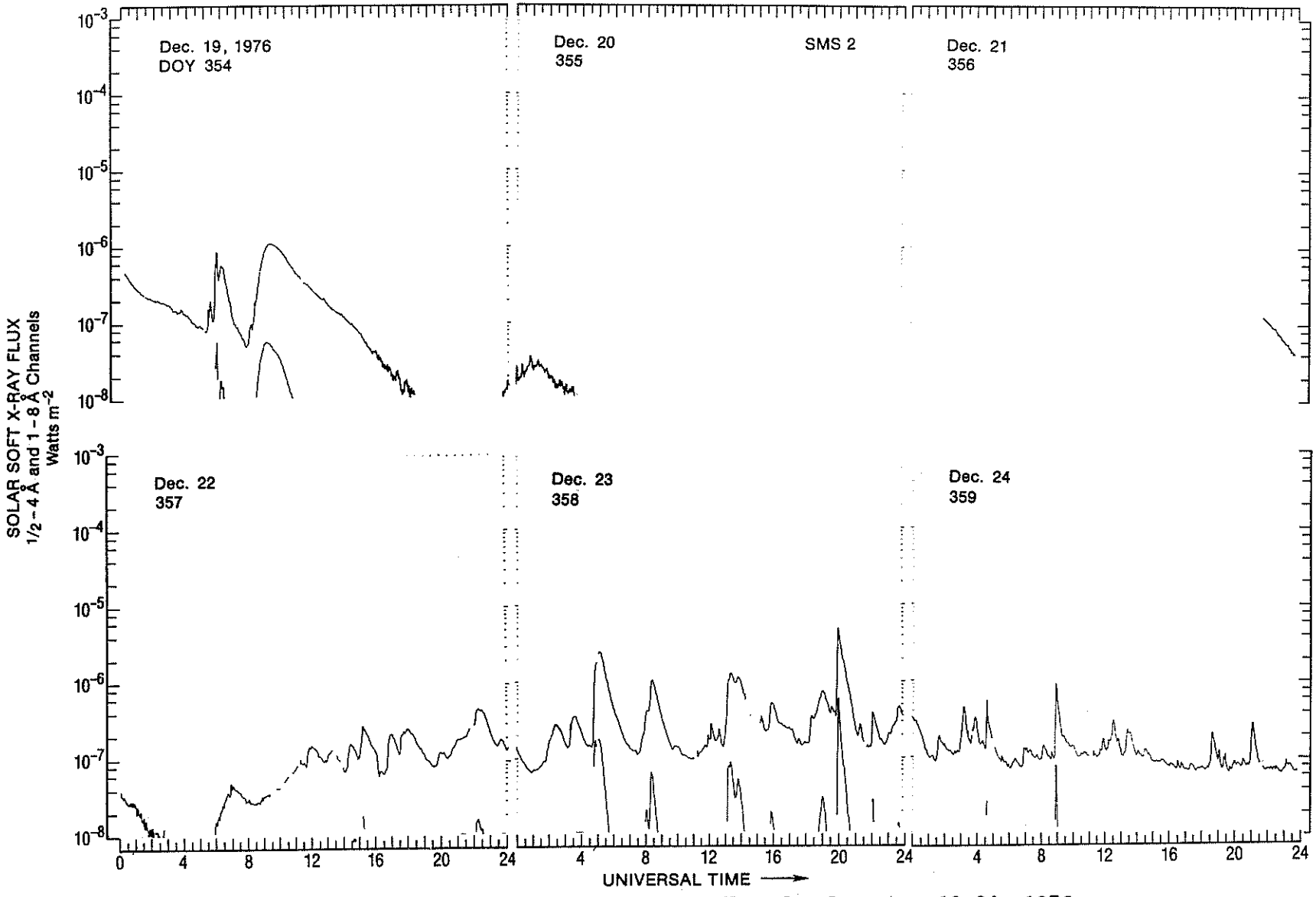


Figure 167. SMS-2 solar X-ray flux for December 19-24, 1976.

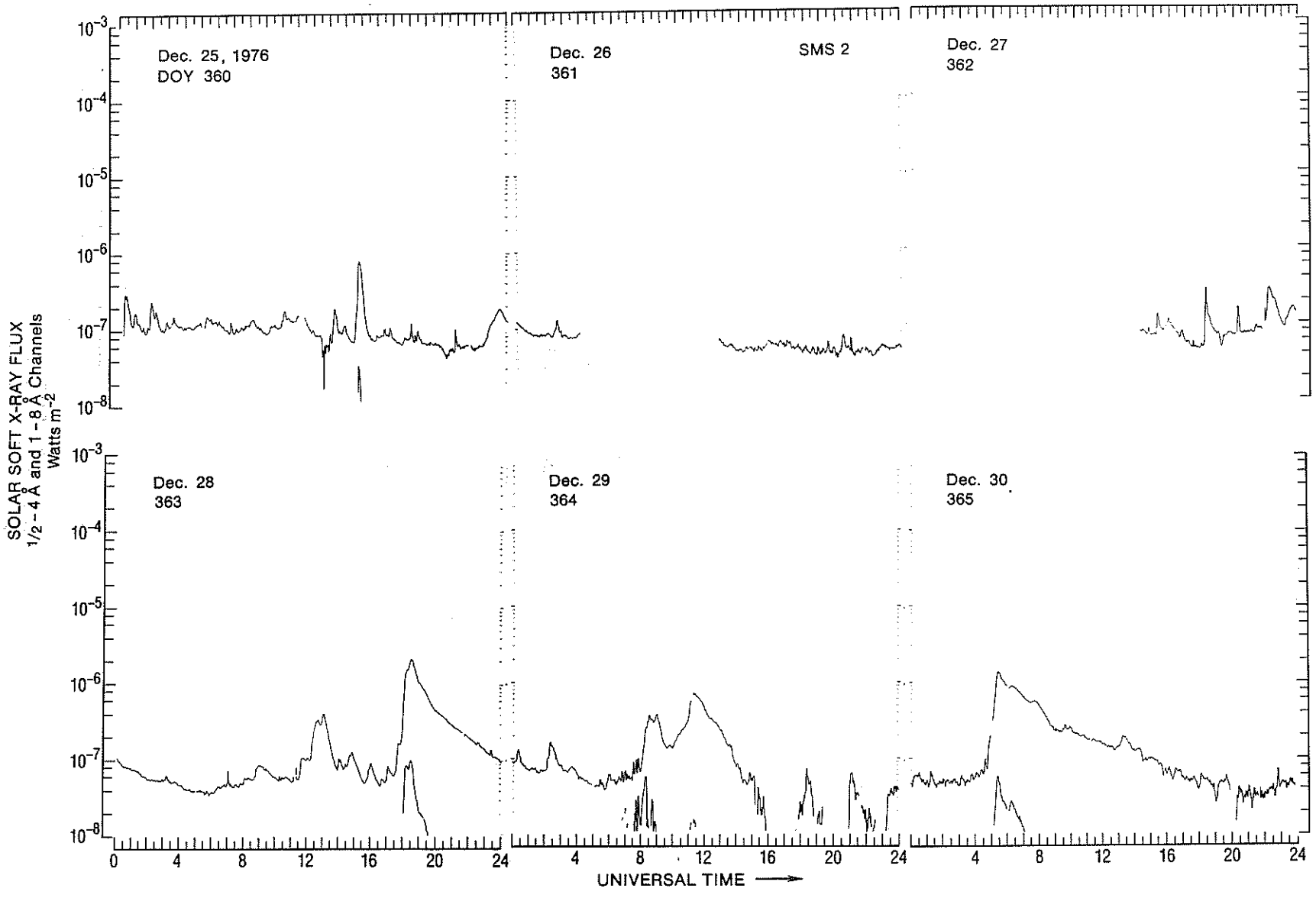


Figure 168. SMS-2 solar X-ray flux for December 25-30, 1976.

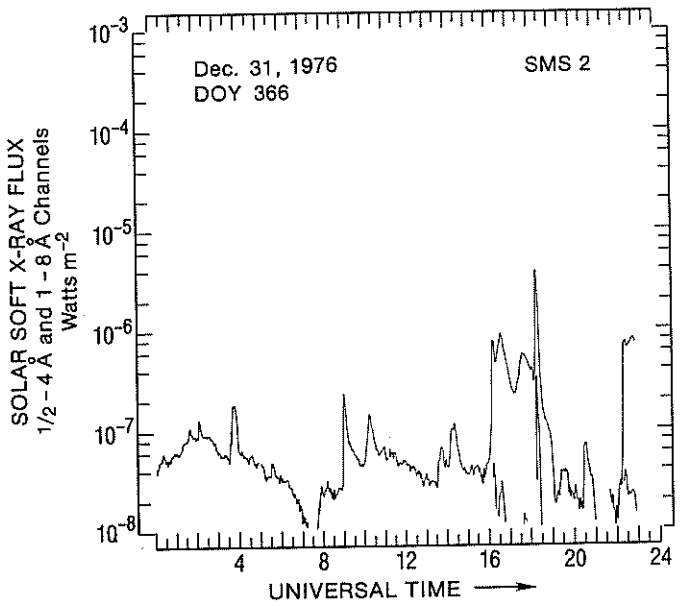


Figure 169. SMS-2 solar X-ray flux for December 31, 1976.

3. ACKNOWLEDGEMENTS

J. Dean Schroeder, III helped by searching old data logs to sort out disputed data. Frank Cowley and Donna Battchelor performed vital data processing and archiving work. Dan Marvin, Helen Coffey and Viola Miller of NOAA EDIS helped in obtaining the daily microfilm graphs of SMS-GOES X-ray data. I am grateful for the help of David Klock and Doris Donnelly in mounting the hundreds of microfilm prints to make the figures. Thanks also to Jim Adams for drafting labels and heavier tick marks to make the graphs more readable in their final photoreduced size. S. David Bouwer helped recover GOES-1 data for May - July, 1976.

4. REFERENCES

Dodson, H.W., and E.R. Hedeman, 1975, Comments on the course of solar activity during the declining phase of solar cycle 20 (1970-1974), Solar Phys., 42, 121-130.

Donnelly, R.F., R.N. Grubb and F.C. Cowley, 1977, Solar X-Ray Measurements from SMS-1, SMS-2, and GOES-1 Information for Data Users, NOAA Technical Memorandum ERL SEL-48, NOAA ERL SEL, Boulder, Colorado 80303.

Donnelly, R.F., R.B. Fritz, 1975, ATS Observations of Sudden Increases of Total Electron Content Induced by EUV and X-Ray Burst of Solar Flares, NOAA Tech Rept ERL 347-SEL 35, Superintendent of Documents, U.S. Government Printing Office. Washington, D.C. 20402, 37 pp.

Feibelman, W.A., 1974, Visual and photographic white light flare observations of 4 July 1974, Solar Phys., 39 409-413.

Kaufmann, P., P. Iacomo, Jr., E.H. Koppe, P. Marques dos Santos, R.E. Schaal, and J.R. Blakey, 1975, The July 1974 solar events: a possible lower limit for microwave activity, Solar Phys., 45, 189-197.

Steffen P., 1975, A radio burst with peculiar polarization behavior in July 1974, Solar Phys., 44, 149-153.

Tang. F., 1978, Umbral flares, Solar Phys., 60, 119-122.

Tindo, I.P., A.I. Shuryghin and W. Seffen, 1976, The polarization of X-ray emission of some solar flares in July 1974, Solar Phys., 46, 219-227.

☆ U. S. GOVERNMENT PRINTING OFFICE 1981 - 777-002/1256 Reg. 8