5.0 NESDIS Operational Products

SSB presently archives several different types of NESDIS operational polar orbiter products. The products include atmospheric soundings, sea surface temperatures, heat budget, mapped/gridded AVHRR data, TOVS and AVHRR Level 1b data (which have been previously described in Sections 2, 3, and 4), and total and profile ozone data. Tables 5.0-1 through 5 contain a detailed list of the specific NESDIS products which are available. The sounding products in Table 5.0-1 are known as the TOVS sounding products which are described in Section 5.1. The sea surface temperature products in Table 5.0-2 are produced from quantitative processing of digital radiometric measurements (AVHRR) and are described in Section 5.2. The mapped GAC
products contained in Table 5.0-3 (Polar Stereographic and Mercator GAC mosaics) are described in Section 5.3. Heat budget products listed in Table 5.0-4 are described in Section 5.4. The ozone products generated from the Solar Backscattered Ultraviolet Radiometer Version 2 (SBUV/2) and listed in Table 5.0-5 are described in Section 5.5.

The TOVS sounding product information is derived from the three TOVS instruments. These instruments consist of the HIRS/2, MSU, and SSU sensors (described in previous sections) which measure the intensity of the upwelling radiation in the various spectral intervals that occur at maxima over broad layers and depths of the atmosphere. These radiance measurements are processed into Earth-located, calibrated radiance values, "clear" radiances (radiances corrected for cloud effects and angle of view), estimates of water vapor in three atmospheric layers (converted to precipitable water in these layers), mean temperatures for selected atmospheric layers, tropopause height and temperature estimates, and geopotential thickness of selected atmospheric layers.

The digital AVHRR data are processed into the quantitative products of global sea surface temperatures and global radiation budget estimates.

The GAC infrared and visible data are processed into a basic set of sea surface temperature (SST) observations at 8-km resolution (50-km prior to Nov. 17, 1981) over the global oceans. All observations are values which have been integrated over an 8-km diameter spot, however, they have a variable spacing, ranging from 8-km (contiguous) in the U.S. coastal waters to 25-km in the open ocean. This data base is further processed to generate gridded analyses at the regional, global, and local scales. The Regional-Scale analyses (50 km resolution) are over five selected regions on a 0.5 degree latitude/longitude grid. The Global-Scale analysis covers the global oceans at 100-km resolution (1 degree latitude/longitude grid) and the Local-Scale analyses are at 14-km resolution (.125 degree latitude/longitude grid) over eight selected regions.

The Radiation Budget archive consists of six types of similar data. One type is the Monthly Radiation Budget consisting of daily values of day flux, night flux, absorbed solar energy, and available solar energy for a month. These data are available in Polar Stereographic and Mercator projections. Another type of Radiation Budget product is the Seasonal Radiation Budget which has the same daily radiation fields as the Monthly Radiation Budget product. But, in addition to Polar Stereographic and Mercator projections, there is a smaller (45 x 45) polar chip included and, the data range over a three-month season. A subset of the Seasonal Radiation Budget product is now available for ten years in the Mercator format, and is called the Ten-year Mercator Radiation Budget product. The fourth type of Radiation Budget product is the Monthly Mean Radiation Budget which contains monthly averages for the above mentioned radiation fields. These data are also available in Polar Stereographic and Mercator projections. The fifth and sixth types of radiation budget data products are the seasonal mean and annual mean. The seasonal mean product are averages over each season while the annual mean product are averages calculated over each calendar year.

The gridded AVHRR products consist of mosaics of orbital passes of unmapped data and the mapped AVHRR products consist of Mercator and Polar Stereographic map projections. The mapped mosaics are of daytime visible and infrared, and nighttime infrared imagery. Note that as of June 24, 1985, the Mercator mosaics became available in digital form in addition to the already available Polar Stereographic mosaics.

There are three types of SBUV/2 ozone products. They are the 1B Capture product, the Historical Instruments file product and the Product Master File product.

Table 5.0-1. TOVS Sounding Products on CCT

Product Description	Accuracy Goals	Coverage/Spatial Resolution
Layer-mean temperatures (K) for the layers listed below: surface - 850 mb; 850-700 mb; 700-500 mb; 500-400 mb; 400-300 mb; 300-200 mb; 200-100 mb; 100-70 mb; 70-50 mb; 50-30 mb; 30-10 mb; 10-5 mb; 5-2 mb; 2-1 mb; 1-0.4 mb.	Surface-850 mb: +/- 2.5K; 850-tropopause: +/- 2.25K; tropopause-2 mb: +/- 3K; 2-4 mb: +/- 3.5K	Global coverage. Nominal 250 km near the subsatellite track. Spacing and resolution increase with scan angle. Resolution will be fixed at 250 km nominal.
Layer precipitable water (mm) for these layers: surface-700 mb; 700-500 mb; above 500 mb	+/- 30%	Same as above.
Tropopause pressure (mb) and temperature	Pressure: +/- 50 mb; temperature: +/- 2.5 degrees	Same as above.
Total ozone (Dobson units)	+/- 15% tropical; +/- 50% polar	Same as above.

Equivalent Blackbody temperatures (K) for 20 HIRS/2 stratospheric channels, 4 MSU channels, and 3 SSU channels	+/- 2K	Same as above.
Cloud cover	+/- 20%	Same as above.

Table 5.0-2. Sea Surface Temperature Products

Product Description	Accuracy Goals	Spatial Resolution/ Geographical coverage	Format/Schedule
1) Sea Surface Temperature Observations	+/- 1.5 degrees C absolute; +/- 1.5 degrees relative	8 km (nominal/Global)	CCT - weekly
2) Sea Surface Temperature Regional-Scale Analysis	See above.	0.5 degree lat/long grid (50 km); 5 regions	Image - weekly; CCT - monthly
3) Sea Surface Temperature Global-Scale	See above.	1 degree lat/long grid (100 km)	Contour chart - weekly; CCT- bimonthly; Image - daily
4) Sea Surface Temperature Local-Scale Analysis	See above.	0.125 degree lat/long grid (14 km); 8 regions	2 CCTs - monthly; Image - daily
5) Sea Surface Temperature Monthly Mean	See above.	Global 2.5 degrees lat/long grid (250 km)	CCT - yearly; Contour chart - monthly

Table 5.0-3. Mapped/Gridded AVHRR Product

Product Description	Accuracy Goals	Coverage/Spatial resolution	Format/Schedule
1) Hemisphere Mapped GAC Polar mosaics IR and VIS mosaics	Nominal +/- 5 km for polar and Mercator mapping location	Northern/Southern Hemispheres 1024 x 1024; 14.8 km at Equator; 29.6 km at poles	Mapped imagery - CCT daily

2) Mercator Mapped GAC Mosaics IR/VIS	See above.	360 degree longitude; 40N-40S; 9.8 km at Equator, increasing poleward	Mapped imagery CCT daily (beginning May 31, 1985)
3) Polar Mapped GAC composites IR/VIS (minimum Brightness/maximum temperatures)	See above.	North/South polar Regions 1024 x 1024	Mapped - conforms to 7 day compositing period
4) Pass-by-pass Gridded GAC imagery VIS/IR (one satellite)	Nominal +/- 5 km grid placement	Global 4 km	Gridded imagery - orbit by orbit
5) Imagery from LAC data: both recorded and Direct Readout (ungridded)	n/a	Recorded data: selectable; two 11.5 minute segments/orbit. Direct Readout Continental U.S.	Imagery - recorded: variable two 11.5 minute segments/orbit. Direct Readout all Continental U.S.

Table 5.0-4. Radiation Budget Products

Product Description	**Accuracy Goals**	**Coverage/ Spatial Resolution**	**Format/Schedule**
Monthly Radiation Budget Parameters	+/- 7 W/m^2 reflected outgoing energy	Global; Observa-tions are 50km	CCT (January 1979 to present) a. 2.5 x 2.5 degree Mercator map array b. 125 x 125 polar map array 2 times/day IR flux; 1 time/day reflected energy; monthly (time average)
1. Daytime Longwave Flux	+/- 7 W/m^2	Global	See above.
2. Nighttime Longwave Flux	+/- 7 W/m^2	Global	See above.
3. Absorbed Solar Radiation	+/- 7 W/m^2	Global	See above.

4. Available Solar Energy (calculated field to be included in output form)	+/- 7 W/m^2	Global	See above.
Seasonal Radiation Budget Parameters	+/- 7 W/m^2	Global	CCT (June 1974 to present) a. 125 x 125 polar stereo map array b. 45 x 45 polar stereo chip array c. 144 x 72 (2.5 x 2.5 degree) Mercator array Daily data for a 3-month season
1. Daytime Outgoing Longwave	+/- 7 W/m^2	Global	See above.
2. Absorbed Solar Energy	+/- 7 W/m^2	Global	See above.
3. Available Solar Energy	+/- 7 W/m^2	Global	See above.
4. Nighttime Outgoing Longwave	+/- 7 W/m^2	Global	See above.
10-year Mercator Heat Budget Parameters	+/- 7 W/m^2	Global	CCT a. 144 x 72 (2.5 x 2.5 degree) Mercator map array Daily data for 10 years. (June 1974 - March 1978, January 1979 - February 1986)
1. Daytime Outgoing Longwave	+/- 7 W/m^2	Global	See above.
2. Absorbed Solar Energy	+/- 7 W/m^2	Global	See above.
3. Available Solar Energy	+/- 7 W/m^2	Global	See above.
4. Nighttime Outgoing Longwave	+/- 7 W/m^2	Global	See above.
Monthly Mean Heat Budget Parameters	+/- 7 W/m^2	Global	CCT (January 1979 to present) a. 144 x 72 (2.5 x 2.5 degree) Mercator map array b. 125 x 125 Polar stereo map array
1. Daytime IR Flux	+/- 7 W/m^2	Global	See above.

2. Nighttime IR Flux	+/- 7 W/m^2	Global	See above.
3. Absorbed Solar Energy	+/- 7 W/m^2	Global	See above.
4. Available Solar Energy	+/- 7 W/m^2	Global	See above.

Table 5.0-5. SBUV/2 Ozone Products

Product Description		**Accuracy Goals**	**Coverage/Spatial Resolution**
Total Ozone (Dobson units)		1%	Global
Layer Ozone (Dobson units), layers:		5%	Global
Layer number	Pressure range (mb)		
1	surface - 250		
2	250 - 125		
3	125 - 63		
4	63 - 31		
5	31 - 16		
6	16 - 8		
7	8 - 4		
8	4 - 2		
9	2 - 1		
10	1 - 0.5		
11	0.5 - 0.25		
12	0.25 - 0.1		
Level Ozone (micrograms/gram), levels:		5%	Global
Level number	Pressure (mb)		
1	0.3		
2	0.4		
3	0.5		

4	0.7		
5	1.0		
6	1.5		
7	2		
8	3		
9	4		
10	5		
11	7		
12	10		
13	15		
14	20		
15	30		
16	40		
17	50		
18	70		
19	100		

5.1 TOVS Sounding Product

NESDIS currently has the capability of producing a maximum of 100,000 soundings every 24 hours from two operational spacecraft. Up until March 9, 1992, the soundings were 250 km resolution and only those classified as "good" were archived. Beginning March 9, 1992, **all** the soundings were included ("good" and "redundant", not sampled) on the archive tape with their resolution increased to 80 km. These soundings are provided to SSB on a weekly basis.

Section 5.1.1 contains a description of the format used for the TOVS Sounding Product between January 1979 and March 8, 1992. As of March 9, 1992, a modified format for the TOVS Sounding Product was implemented because of a change in archive media - seven days of soundings are written to one IBM 3480 cartridge each week. A description of this format is contained in Section 5.1.2.

5.1.1 TOVS Sounding Product (Jan. 1979 - March 8, 1992)

The data volume required for the TOVS Sounding Product for one week for one satellite is approximately one-third of a 9-track, 6250 BPI tape. Therefore, when there is only one operational satellite, three weeks worth of sounding data can be stacked on one CCT. However, when there are two operational satellites, the sounding data will be intermixed and in chronological order on one weekly CCT.

Individual soundings stored on tape are formatted according to the NMC/NESDIS Data Set Format which is described in detail later in this section. Each tape contains a data directory found at the beginning of the tape which will describe the contents of the tape. The data directory acts as a housekeeping file and consists of two parts: 1) an element containing directory information, and 2) the elements related to the data on the tape. The purpose of the NMC/NESDIS archive housekeeping file is to aid users in determining the location of time categorized, satellite-derived soundings on the tape. The end of each group of time-categorized soundings, as described by the individual data directory elements, is indicated by an end of file (EOF). A double EOF marks the end of data on tape as described by the last directory element in the housekeeping file. Together, the EOF markers and the housekeeping file are intended to provide the user with a means of selectively choosing soundings from the tape.

The format of the NMC/NESDIS archive housekeeping file is in two parts. The first part of the file is the Directory Information Element which contains 20 bytes or ten 2-byte words in the format shown in Table 5.1.1-1.

Table 5.1.1-1. Directory Information Element

Byte #	Contents
1-2	Number of data directory elements in housekeeping file
3-6	Total number of soundings (reports) on the tape

7-8	Processing year (2 digits)
9-10	Processing month (2 digits)
11-12	Processing day (2 digits)
13-20	Spares (denoted by "6666_{10}")

The second part of the housekeeping file is the Data Directory Element which contains 20 bytes per element in the format shown in Table 5.1.1-2.

Table 5.1.1-2. Data Directory Element

Byte #	Contents
1-2	Time category of reports stored
3-4	Number of reports in time category
5-6	Year of reports (Century x 256 + year)
7-8	Month and day of reports (Month x 256 + day)
9-10	Time of day (UTC) of earliest report (Hours x 256 + minutes)
11-12	Time of day (UTC) of latest report (Hours x 256 + minutes)
13-20	Spares (denoted by "6666_{10}")

Digital data may be selected from the TOVS Sounding Product tapes by time and/or area. Each record that contains any of the selection criteria will be included in its entirety. Note: if the TOVS Sounding Product selection software is run, the housekeeping file is not included with the selected data. Using the selection software, a 1600 BPI CCT holds approximately 131,000 soundings, while a 6250 BPI CCT holds approximately 455,000 soundings. Specific orbits cannot be selected with the existing software.

The time category (listed as the first two bytes of the Data Directory Element) is defined in Table 5.1.1-3. If the value of the time category number equals 10 + the category number, it will denote that the soundings for that data directory element are of bad quality.

Table 5.1.1-3. Time Category

Category Number	Time Range (UTC)
1	0000 - 0259
2	0300 - 0559

3	0600 - 0859
4	0900 - 1159
5	1200 - 1459
6	1500 - 1759
7	1800 -2059
8	2100 - 2359

The overall structure of each TOVS Sounding Product archive tape is shown in Figure 5.1.1-1. It shows the n+1 elements in the housekeeping file and the corresponding TOVS soundings files which are in the NMC/NESDIS Data Set Format.

Figure 5.1.1-1. Structure of TOVS Sounding Product Tape

Directory Information Element Data Directory Element #1 Data Directory Element #2 Data Directory Element #3 ... Data Directory Element #n EOF	Housekeeping File
TOVS Soundings described by Data Directory Element #1 EOF	Data Files
TOVS Soundings described by Data Directory Element #2 EOF	
...	
TOVS Soundings described by Data Directory Element #n EOF	
TOVS Quality information (since 1989) EOF	
EOF	

The TOVS Sounding Product tape has a logical record length of 280 bytes and a block size (physical record length) of 6,440 bytes. However, the housekeeping file has a variable length physical record. It ranges from a minimum of 280 bytes to a maximum of 3080 bytes because of the variable nature of the directory. The 6,440-byte block size holds 23 reports of 280 bytes each. Thus, each report occupies one logical record. A missing or undefined data value is denoted by "7777_{10}", a spare is "6666_{10}", and an end-of-report is indicated by "8888_{10}". The TOVS Sounding data files are written in the NMC/NESDIS Data Set Format. This format is in binary and contains 44 bytes of documentation and 236 bytes of Sounding Products/information for a maximum of seven data type categories. The format for the documentation portion is contained in Table 5.1.1-4.

Table 5.1.1-4. NMC/NESDIS Documentation Format	
Byte #	**Content**
1-2	Satellite Identification (see Section 2.0.2)
3-4	Year (last two digits) x 256 + Month
5-6	Day x 256 + Hour (UTC)
7-8	Minutes x 256 + Seconds (UTC)
9-10	Latitude (degrees x 100, +N, -S, Range: +90 to -90)
11-12	Longitude (degrees x 100, +E, -W, Range: +180 to -180)
13-14	Solar Zenith Angle (degrees x 100, +Day, -Night, Range: +90 to -90)
15-16	Land/Sea Indicator (if land, surface elevation in meters; if sea, zero)
17-18	Surface (skin) temperature (K x 10)
19-20	Estimated Surface Model Pressure (mb x 10)
21-22	Instrument and/or Channel combination used to obtain various products
23-24	Retrieval Method
25-26	Standard Deviation of Low-level HIRS/2 Channel (7) (K x 100, range: 0 to 10)
27-28	Standard Deviation of Mid-level HIRS/2 Channel (5) (K x 100, range: 0 to 10)
29-30	Average value of N*, range: 0 to 1 (dimensionless x radiance values when there are some clouds obstructing the surface.)
31-32	Superswath Box counter and minibox (Superswath x 1000 + Box counter x 10 + minibox)
33-34	Sea Surface Temperature (K x 10). SST over ocean, skin temperature over land.
35-36	Day of Month and Hour (UTC) when Edit Flag is written to file. Scaling: (Day x 256) + Hour
37-38	Minute and Second (UTC) when Edit Flag is written to file. Scaling: (Minute x 256) + Seconds
39-40	TOVS Filter Flag: 0 = sounding is good; 1 = sounding is redundant

41-44	Special Counter for 7-Day Archive Tape (address of start on disk)
Note: A value of N* between 0 and 1000 indicates that the N* method was used. A value of "7777" indicates missing data and implies that the HIRS radiances are completely clear and the N* method was not used. A value of "9211" means that the HIRS radiances are completely cloudy and the user should check the channel combination flags to determine which channels were used.	

A superswath is defined as the 40 scan lines of HIRS/2 data between calibration modes, while a box is 7 lines x 9 spots, and a minibox is 3 lines x 3 spots. There are a maximum of 26 superswaths per orbit.

Table 5.1.1-5 contains the format of the sounding products/information (arranged in categories). Category 6 contains radiometric information supplied in the form of equivalent Blackbody or brightness temperatures. These can be transformed to radiances ($mW/(m^2\text{-}sr\text{-}cm^{-1})$) by application of the Planck function. The Planck function requires channel central wave numbers and temperature-adjustment coefficients which are spacecraft/instrument dependent and available in Section 1.4.

Table 5.1.1-5. NMC/NESDIS Sounding Products/Information Format

Byte #	Content
Category 1 - Layer Mean Temperature (Maximum 15 layers)	
45-46	Pressure at lower boundary (mb x 10)
47-48	Pressure at upper boundary (mb x 10)
49-50	Layer-mean temperature (K x 10)
51-52	Quality (K x 10)
53-164	Repeat of Category 1 data for 14 more layers
Category 2 - Layer Precipitable Water (Maximum 3 layers)	
165-166	Pressure at lower boundary (mb x 10)
167-168	Pressure at upper boundary (mb x 10)
169-170	Layer Precipitable Water (mm)
171-172	Quality (percent)
173-188	Repeat of Category 2 data for two more layers
Category 3 - Tropopause Parameters	

189-190	Pressure (mb x 10)
191-192	Temperature (K x 10)
193-194	Quality (mb x 10)
195-196	Spare
Category 4 - Ozone	
197-198	Total ozone amount (Dobson units)
199-200	Quality (percent)
Category 5 - Cloud Cover	
201-202	Pressure (mb x 10)
203-204	Amount (Percent)
Category 6 - Sounding Radiances	
205-244	Twenty HIRS/2 Channel Equivalent Blackbody Temperatures (K x 64 except for Channel 20 which has K x 16)
245-252	Four MSU Channel Equivalent Blackbody Temperatures (K x 64)
253-258	Three SSU Channel Equivalent Blackbody Temperatures (K x 64)
259-260	Spare
261-276	**New Category(s) Spare**
277-278	Spare
279-280	End of Report

The documentation portion of the NMC/NESDIS Data Set Format contains two bytes (bytes 21-22) which indicate the instrument and/or channel combination used to obtain various products. ICC represents the value in this byte, and is defined as shown in Equation 5.1.1-1,

$$ICC = 4096\,Z + 256Y + 16X + 4W + V \qquad 5.1.1\text{-}1$$

Table 5.1.1-6 describes the variables that comprise ICC.

Table 5.1.1-6. Variables that Comprise ICC	
V	denotes channel combinations used to obtain layer precipitable water for the layers: surface to 700 mb, 700 to 500 mb, and 500 to 300 mb. V can have the following values:

	0 No Retrieval
	1 HIRS/2 + MSU
	2 HIRS/2
W	denotes channel combinations used to obtain tropopause temperature and pressure. W can have the following value:
	0 No Retrieval
	1 HIRS’ + MSU
	2 HIRS/2
X	denotes channel combinations used to obtain total ozone. X can have the following values:
	0 No Retrieval
	1 HIRS/2 (1, 2, 3, 8, 9, 16, 17) + MSU (4)
	2 HIRS/2 (1, 2, 3, 8, 9, 16, 17)
	3 HIRS/2 (1, 2, 3, 9, 17) + MSU (4)
	4 HIRS/2 (1, 2, 3, 9, 17)
Y	denotes channel combinations used to obtain mean temperature for the layers: surface to 850 mb, 850 to 700 mb, 700 to 500 mb, 500 to 400 mb, 400 to 300 mb, 300 to 200 mb, 200 to 100 mb. Y can have the following values:
	0 No Retrieval
	1 HIRS/2 + MSU
	2 HIRS’ + MSU
	3 HIRS/2
	4 MSU
	5 HIRS’ + MSU + SKINTK (ocean only)
	6 MSU + SKINTK (ocean only)
Z	denotes channel combinations used to obtain mean temperature for the layers; 100 to 70 mb, 70 to 50 mb, 50 to 30 mb, 30 to 10 mb, 10 to 5 mb, 5 to 2 mb, 2 to 1 mb, 1 to 0.4 mb. Z can have the following values:
	0 No Retrieval
	1 HIRS’ + SSU + MSU (3,4)

	2 HIRS' + MSU (3,4)
	3 SSU + MSU (3,4)
	4 HIRS' + SSU
	5 HIRS'
	6 MSU (3,4) (Output will terminate at 10 mb since there is no meaningful data above that level in this case.)
Note that HIRS' is equivalent to HIRS/2 Channels 1 (668 cm^{-1}), 2 (679 cm^{-1}), 3 (691 cm^{-1}), and 17 (2360 cm^{-1}).	

The retrieval method is contained in bytes 23 and 24 of the documentation portion of the NMC/NESDIS Data Set Format. METREC represents the value in the two bytes, and is defined by Equation 5.1.1-2,

$$\text{METREC} = 256A + 16B + C \qquad 5.1.1\text{-}2$$

Table 5.1.1-7 describes the variables that comprise METREC.

Table 5.1.1-7. Variables that Comprise METREC.

A =	0	No HIRS/2 data.
	1	Clear radiances are derived from completely clear spots.
	2	Clear radiances derived from the N^* approach.
B =	0	No HIRS/2 data.
	1	All HIRS/2 channels were used in the retrieval.
	2	The tropopause HIRS/2 channels were unusable due to clouds and only stratospheric channels were used in the retrieval.
C =	0	A statistical retrieval method was used.
	1	The minimum information retrieval was used.
	2	The minimum information retrieval was attempted, but the statistical retrieval was used.

5.1.1.1 TOVS Quality Information File (Sept. 1989 - March 8, 1992

Since September 1989, TOVS quality information as required by NOAA's Climate and Global Change Program, has been generated and written to the last file (usually file 58) of the TOVS Sounding Product archive tape. This quality information is cumulative (e.g., the quality information written during the week of Jan. 8, 1990, contains quality statistics from July 1989 through Jan. 7, 1990). Statistics were generated beginning in July 1989 but were not written to the archive tape until September 1989.

Table 5.1.1.1-1 shows the general structure of the TOVS quality information file. The housekeeping record (record 1) has the format shown in Table 5.1.1.1-2, while the directory records (records 2 to 8) have the format shown in Table 5.1.1.1-3. Data records (records 9 to 848) have the format shown in Table 5.1.1.1-4. Each directory record contains 120 directory elements. Each element is a group of 12 words containing information on the corresponding data record (described in Table. 5.1.1.1-4).

Table 5.1.1.1-1. General Structure of the TOVS Quality Information File.

Record #	Contents
1	Housekeeping record (see Table 5.1.1.1-2)
2-8	Directory records (see Table 5.1.1.1-3)
9-848	Data records (see Table 5.1.1.1-4)

Table 5.1.1.1-2. Format of the Housekeeping Record for the TOVS Quality Information file.

Word # (I*4)	Contents
1	Total number of records in the file (848)
2	Last record updated
3	Last record updated at the time the file was archived on tape
4	Beginning record number of directory (2)
5	Beginning record number of data (9)
6-720	Spares (fill = -1_{10})

Table 5.1.1.1-3. Format of Directory Record for the TOVS Quality Information File.

Record # (I*2)	Contents
2	Directory of data records 9 - 128 (fill = -1_{10})
3	Directory of data records 129 - 248
4	Directory of data records 249 -368
5	Directory of data records 369 - 488
6	Directory of data records 489 - 608

7	Directory of data records 609 - 728
8	Directory of data records 729 - 848

Table 5.1.1.1-4. Format of the Data Record for TOVS Quality Information File.

Word #	Contents
1	Start month
2	Start day
3	Start year
4	End month
5	End day
6	End year
7	Plot title code
8	Data type code
9	Satellite ID
10	Record number
11	Thickness/Virtual temperature indicator
12	Spare (fill = -1_{10})

Table 5.1.1.1-5 contains the format of the TOVS quality information data records. The format included in Table 5.1.1.1-5 is for records 9 to 848, which are data records (all words are INTEGER*2 with fill = -1_{10}. These 1440 words are repeated for each week on the file.

Table 5.1.1.1-5. Format of TOVS Quality Information Data Records

Word #	Description	Scaling
1-240	Zone 1 (90N - 60N)	n/a
1-60	Mean (retrieval - radiosonde)	n/a
1-30	Temperature (1000 - 10 mb)	100
31-44	Thickness/Virtual Temperature (1000 - 10 mb)	10
45	Tropopause temperature	100
46	Tropopause pressure	10

47-60	Mixing ratio (1000 - 350 mb)	100
61-120	Root Mean Square (Retrieval -radiosonde)	n/a
61-90	Temperature (1000 - 10 mb)	100
91-104	Thickness/Virtual Temperature (1000 - 10 mb)	10
105	Tropopause temperature	100
106	Tropopause pressure	10
107-120	Mixing ratio (1000 - 350 mb)	100
121-180	Standard deviation (σ)	n/a
121-150	Temperature (1000 - 10 mb)	100
151-164	Thickness/Virtual Temperature (1000 - 10 mb)	10
165	Tropopause temperature	100
166	Tropopause pressure	10
167-180	Mixing ratio (1000 - 350 mb)	100
181-240	Sample size (N)	n/a
181-210	Temperature (1000 - 10 mb)	1
211-224	Thickness/Virtual Temperature (1000 - 10 mb)	1
225	Tropopause temperature	1
226	Tropopause pressure	1
227-240	Mixing ratio (1000 - 350 mb)	1
241-480	Zone 2 (60N to 30N). Format same as for Zone 1.	n/a
481-720	Zone 3 (30N to 0). Format same as for Zone 1.	n/a
721-960	Zone 4 (0 to 30S). Format same as for Zone 1.	n/a
961-1200	Zone 5 (30S to 60S). Format same as for Zone 1.	n/a
1201-1440	Zone 6 (60S to 90S). Format same as for Zone 1.	n/a

5.1.2 TOVS Sounding Product (March 9, 1992 - May 31, 1998)

Beginning with the data for March 9, 1992, the format for the TOVS Sounding Product has changed. This section describes the new format and how it relates to the old format.

The TOVS sounding product currently consists of a full resolution file, which replaces the former archive of a sampled data set. Some of the changes which have been implemented in this new format include the following:

1) The number of words in each data record remains the same at 140 words. Each variable is INTEGER*2 and the logical record length is fixed at 280 bytes.

2) The new format consists of one large file for all the TOVS data (instead of 57 small files) plus a separate file containing the TOVS Quality information file.

3) There is no longer a housekeeping file at the beginning of the data.

4) The TOVS quality information file is contained in a separate file from the normal TOVS Sounding data and must be specifically ordered from SSB if desired.

5) The archive media changed from 9 track 6250 bpi magnetic tape to IBM 3480 cartridges.

The number of records on the cartridge varies from week to week. Before Sept. 21, 1992, the data were blocked into 6440 byte physical records. Each physical record contained 23 logical records of 280 bytes each. To minimize space on the cartridge, the block size was changed to 31,920 bytes beginning with the data on Sept. 21, 1992. Currently each physical record (block) contains 114 logical records of 280 bytes each. Each logical record comprises a report and is composed of 140 INTEGER*2 words (280 bytes). The data are separated into three-hour time periods, thus there are eight possible time periods in a day. The last two data records of each time period are fillers, i.e., every byte in the record is set to a value of "-333_{10}". Although the format of the old and the new TOVS Sounding data records are very similar, for clarification purposes, the format for the new data record is repeated in Table 5.1.2-1.

Table 5.1.2-1. Format of New TOVS Sounding Product Data Record.

Word #	Contents
1	Satellite Identification (see Section 2.0.2)
2	Year x 256 + Month
3	Days x 256 + Hours (UTC)
4	Minutes x 256 + Seconds
5	Latitude (degrees x 100, +N, -S, range: +90 to -90)
6	Longitude (degrees x 100, +E, -W, range: +180 to -180)
7	Solar Zenith Angle (degrees x 100, range: 0 to 90, 90=night)
8	Land/Sea indicator (if land, surface elevation in meters; if sea, zero)

9	Surface temperature (K x 10)
10	Estimated pressure at base of sounding (mb x 10)
11	Instrument and/or channel combination
12	Retrieval method
13	Standard deviation for low-level channel (K x 100, range: 0 to 10)
14	Standard deviation for medium-level channel (K x 100, range: 0 to 10)
15	Mean value of N* (N* x 1000, range: 0 to 1)
16	Superswath, box and minibox counter (superswath x 1000 + box counter x 10 + minibox)
17	Sea Surface Temperature (K x 10)
18	Day of month and hour (UTC) when edit flag is written to file (Day x 256 + hour)
19	Minute and second when edit flag is written to file (Minute x 256 + seconds)
20	TOVS filter flag (range: 0 to 3)
21-22	Spare
Words 23-82 are Layer mean temperatures	
23	Pressure at low boundary (mb x 10)
24	Pressure at upper boundary (mb x 10)
25	Layer-mean temperature (K x 10)
26	Quality (K x 10)
27-82	Same as words 23-26 for the other 14 layers
Words 83-94 are for layer precipitable water:	
83	Pressure at lower boundary (mb x 10)
84	Pressure at upper boundary (mb x 10)
85	Layer precipitable water (mm)
86	Quality (percent)
87-94	Same as words 83-86 for the other 2 layers
95	Tropopause pressure (mb x 10)
96	Tropopause temperature (K x 10)

97	Tropopause quality (percent)
98	Spare
99	Total ozone amount (Dobson units)
100	Total ozone quality (percent)
101	Cloud cover pressure (mb x 10)
102	Cloud cover amount (percent)
Words 103-130 are for sounding radiances:	
103-121	Equivalent Blackbody temperatures used to obtain HIRS/2 Ch. 1-19, (K x 64)
122	Equivalent Blackbody temperatures used to obtain HIRS/2 Ch. 20, (K x 16)
123-126	Equivalent Blackbody temperatures used to obtain MSU Ch. 1-4 (K x 64)
127-129	Equivalent Blackbody temperatures used to obtain SSU Ch. 1-3 (K x 64)
130	Spare
131	Stability departure
132	Stability departure time difference
133-139	Spares
140	End of report indicated by “8888"
Note: A value of N* between 0 and 1000 indicates that the N* method was used. A value of "7777" indicates missing data and implies that the HIRS radiances are completely clear and the N* method was not used. A value of "9211" means that the HIRS radiances are completely cloudy and the user should check the channel combination flags to determine which channels were used.	

Weekly (on a seven day cycle beginning with Monday), sounding data for two satellites are written onto an IBM 3480 cartridge (which is full). SSB has selection software for this version of the TOVS Sounding Product. Digital data may be selected from the TOVS Sounding Product tapes by time and/or area. Each record that contains any of the selection criteria will be included in its entirety.

The instrument and/or channel combination described in word 11 is represented by ICC, which is defined by Equation 5.1.2-1:

$$ICC = 4096Z + 256Y + 16X + 4W + V \qquad 5.1.2\text{-}2$$

Table 5.1.2-2 describes the variables that comprise ICC.

Table 5.1.2-2. Variables that Comprise ICC	
V	denotes channel combinations used to obtain layer precipitable water for the layers: surface to 700 mb, 700 to 500 mb, and 500 to 300 mb. V can have the following values:
	0 No Retrieval
	1 HIRS + MSU
	2 HIRS
W	denotes channel combinations used to obtain tropopause temperature and pressure. W can have the following values:
	0 No Retrieval
	1 HIRS' + MSU
	2 MSU
X	denotes channel combinations used to obtain total ozone. X can have the following values:
	0 No Retrieval
	1 HIRS (1, 2, 3, 8, 9, 16, 17) + MSU (4)
	2 HIRS (1, 2, 3, 8, 9, 16, 17)
	3 HIRS (1, 2, 3, 9, 17) + MSU (4)
	4 HIRS (1, 2, 3, 9, 17)
Y	denotes channel combinations used to obtain mean temperature for the layers: surface to 850 mb, 850 to 700 mb, 700 to 500 mb, 500 to 400 mb, 400 to 300 mb, 300 to 200 mb, 200 to 100 mb. Y can have the following values:
	0 No Retrieval
	1 HIRS + MSU
	2 HIRS' + MSU
	3 HIRS
	4 MSU
	5 HIRS' + MSU + SKINTK (ocean only)
	6 MSU + SKINTK (ocean only)
	Note: SKINTK is no longer used, so Y values of 2 and 5 are identical, as well as Y values of 4 and 6.

Z	denotes channel combinations used to obtain mean temperature for the layers; 100 to 70 mb, 70 to 50 mb, 50 to 30 mb, 30 to 10 mb, 10 to 5 mb, 5 to 2 mb, 2 to 1 mb, 1 to 0.4 mb. Z can have the following values:
	0 No Retrieval
	1 HIRS’ + SSU + MSU (3,4)
	2 HIRS’ + MSU (3,4)
	3 SSU + MSU (3,4)
	4 HIRS’ + SSU
	5 HIRS’
	6 MSU (3,4) (Note: If Z = 6, output will terminate at 10 mb, since there is no meaningful information above that level in this case.)
Note that HIRS' is equivalent to HIRS/2 Channels 1 (669 cm^{-1}), 2 (679 cm^{-1}), 3 (690 cm^{-1}), and 17 (2358 cm^{-1}).	

The retrieval method in word 12 is indicated by MR, where MR is defined by Equation 5.1.2-2:

$$MR = 256X + 16Y \ Z \qquad 5.1.2\text{-}2$$

Table 5.1.2-3 describes the variables that comprise MR.

Table 5.1.2-3. Variables that Comprise MR		
X indicates:	0	No HIRS/2 data.
	1	Clear radiances are derived from completely clear spots.
	2	Clear radiances are derived from the N^* method.
Y indicates:	0	No HIRS/2 data.
	1	All HIRS/2 channels were used.
	2	Tropospheric HIRS/2 channels were unusable due to clouds only stratospheric channels were used.
Z indicates:	0	Statistical retrieval method was used.
	1	Minimum information retrieval was used.
	2	Minimum information retrieval attempted, but statistical retrieval used.
	3	No HIRS.

Radiometric information are supplied in the form of equivalent Blackbody (or "brightness") temperatures (K). These can be transformed into radiances ($mW/(m^2\text{-sr-}cm^{-1})$) by application of the Planck function. Parameters required for such transformation such as channel central wave numbers and temperature adjustment coefficients are spacecraft instrument dependent and are supplied in respective subsections of Section 1.4 for each satellite.

Spares are indicated by "6666_{10}", missing or undefined values are indicated by "7777_{10}" and end of report is denoted by "8888_{10}".

The TOVS filter flag in word 20 indicates that one of the following conditions is true:

0 Sounding is good
1 Sounding is redundant

Word 17 contains the sea surface temperature value when over ocean and the skin temperature when over land.

5.1.2.1 TOVS Sounding Quality Information File (March 9, 1992 - Present)

The format of the TOVS sounding quality information file is drastically different from the old format. This file is an on-going accumulation of weekly statistics for the TOVS Sounding Product. It contains a housekeeping record which has 720 INTEGER*4 words. The first five words of the housekeeping record are contained in Table 5.1.2.1-1. Words 1 and 3 are the same since the entire file is archived. Word 4 is set to a value of two since the housekeeping record is the first record on the file and the directories follow.

Table 5.1.2.1-1. Format of the Housekeeping Record.

Word # (I*4)	Contents
1	Total number of records on file
2	Last record updated
3	Last record updated at time of archive
4	Beginning record number of directory
5	Beginning record number (i.e., start of data for first directory)
6-720	Zero filled

The directories are dimensioned as 12 x 120 INTEGER*2 arrays. The number of records containing directories can be computed from the housekeeping record: word 5 minus word 4. Table 5.1.2.1-2 contains the format of the directories.

Table 5.1.2.1-2. Format of the Directory Record

Word # (I*2)	Contents
1	Starting month of data period (period is a week)
2	Starting day
3	Starting year
4	Ending month of data period
5	Ending day
6	Ending year
7	Plot title code
8	Data type code
9	Satellite ID
10	Record number of data in file
11-12	Spares (“$FFFF_Z$”)
13-1440	Repeat of word numbers 1-12 for each directory record

Table 5.1.2.1-3 contains the format for the quality information record. Each week, one record of data is written for each operational spacecraft for the clear, N* and cloudy cases. Therefore, in one week for two operational satellites, six data records are created. The data records contain 1440 INTEGER*2 words. Each record contains data for six latitude zones: 90N to 60N, 60N to 30N, 30N to 0, 0 to 30S, 30S to 60S, and 60S to 90S. Unless otherwise specified when ordering, the current quality information file will **not** be included with a customer's order of TOVS Sounding Product data.

Table 5.1.2.1-3. Format of New TOVS Quality Information Record

Word # (I*2)	Description	Scaling
1-240	Zone 1 (90N-60N)	
1-120	**Retrieval temperature (at 30 TOVS levels)**	
1-30	Mean (K)	1000
31-60	Root mean square	1000
61-90	Standard deviation	1000
91-120	Sample size	1000
121-176	**Thickness (at 14 levels)**	

121-134	Mean (m)	100
135-148	Root mean square	100
149-162	Standard deviation	100
163-176	Sample size	100
177-180	**Tropopause temperature**	
177	Mean (K)	1000
178	Root mean square	1000
179	Standard deviation	1000
180	Sample size	1000
181-184	**Tropopause pressure**	
181	Mean (mb)	100
182	Root mean square	100
183	Standard deviation	100
184	Sample size	100
185-240	**Mixing ratio at 14 levels**	
185-198	Mean (g/kg)	1000
199-212	Root mean square	1000
213-226	Standard deviation	1000
227-240	Sample size	1000
241-480	Zone 2 (60N to 30N). Format same as Zone 1.	
481-720	Zone 3 (30N to 0). Format same as Zone 1.	
721-960	Zone 4 (0 to 30S). Format same as Zone 1.	
961-1200	Zone 5 (30S to 60S). Format same as Zone 1.	
1201-1440	Zone 6 (60S to 90S). Format same as Zone 1.	

5.1.3 RTOVS Sounding Product (October 22, 1997 - present)

RTOVS is the Revised TOVS system introduced on October 22, 1997 for NOAA-14 processing and on November 19, 1997 for NOAA-11 processing. RTOVS uses the same instruments as TOVS but newer software designed to easily transition to the new NOAA KLM series of satellites. The format of the archive has been kept the same as TOVS (fully described in Section

5.1.2), to ease data processing by users, although the data volume is higher. There is a parallel archive of TOVS and RTOVS data through May 1998.

5.2 Sea Surface Temperature (SST) Products

SSB archives several NESDIS operational SST products. Once per week, NESDIS produces a tape containing eight days (seven days prior to Nov. 1, 1986) of 8-km resolution (50-km prior to Nov. 17, 1981) SST observations from a current operational TIROS-N series satellite. Twice per month the daily 100-km (Global-Scale Analysis) gridded SST fields produced from these observations are archived to tape. NESDIS produced 500-km gridded SST fields (Climatic-Scale analysis) on a monthly basis until Nov. 1, 1984, when this product was discontinued. NESDIS expanded the Regional-Scale Analysis (50-km) from three regions to five regions on Aug. 1, 1986 and introduced the 14-km gridded (Local-Scale analysis) SST fields over nine selected regions on Jan. 1, 1986. Monthly means are produced from the observations on a 250-km grid (SST Monthly Mean) and archived yearly. Any queries regarding SST products should be directed to the National Climatic Data Center, Climate Services Division, 151 Patton Avenue, Asheville, NC 28801, where all but the latest CCTs containing SST data are currently archived.

The 14-km gridded, 50-km gridded, and 100-km gridded SST fields are generated by NESDIS in the SST Field Format which is described in Section 5.2.1. Section 5.2.2 describes the SST Observation File and the SST Monthly Mean is described in Section 5.2.3.

Most SST archive tapes contain a Header File which will usually be the first file on tape. The Header File consists of one 400-byte physical record which contains some of the information shown in Table 5.2-1.

Table 5.2-1. Format of the SST Header File

Word #	# Bytes	Content	Range
1-20	80	Title of data set archived in File 2 of this tape	1-80 characters with blank fill
21-27	28	Data set name of disk data set	1-28 characters with blank fill
28-29	8	Original archive tape number	1-8 characters with blank fill
Date of earliest data on tape:			
30	1	Year	0-99
	1	Month	1-12
	1	Day	1-31
	1	Blank	n/a
Date of most current data on tape:			

31	1	Year	0-99
	1	Month	1-12
	1	Day	1-31
	1	Blank	n/a
Date and time when data was archived from disk to tape:			
32	4	Year	0-99
33	4	Month	1-12
34	4	Day	1-31
35	4	Hour	0-23
36	4	Minute	0-59
37	4	Second	0-59
38	4	Number of records of data in File 2 of tape	n/a
39	4	Number of files of data on the tape (not counting Header file)	n/a
40-100	244	Spare	n/a

5.2.1 <u>SST Field Format</u>

All of the SST Field products (14-km gridded, 50-km gridded, and 100-km gridded) are derived from the basic 8-km SST observations. An SST Field consists of a specific set of information pertaining to global latitude and longitude intersections. Files have been generated for 0.125 degree, 0.5 degree, and 1 degree latitude-longitude resolution (or 14-km, 50-km, and 100-km resolution, respectively). The Global-Scale (1 degree resolution) file includes the area from 180W to 179E longitude and from -70S to 70N latitude. Using the SST observations as input, NESDIS produces Regional-Scale (50-km) SST analyses and Local-Scale (14-km) SST analyses twice weekly by analyzing all the SST observations obtained during the period since the last analysis.

All resolution field (accumulation) files consist of a Directory Record and a Field Documentation Record, followed by Field Data Records for each field in the accumulation file. Each file (except the Header File) begins with a Directory Record which points to the Field Documentation Record for each field in the file. Details of the Directory Record are contained in Section 5.2.1.1. The Field Documentation Record is described in Section 5.2.1.2, and is always followed by a Field Data Record for each latitude or row of the field. The Field Data Record is described in Section 5.2.1.3.

The fields will generally be arranged in chronological order. A field for a particular day may be missing or repeated so one should examine the Field Documentation Record for each field in the file to find that field spanning the time of interest. The Field Documentation Record (the first record of each field) should be used in referencing the data record for the field since it provides information concerning the organization, size, and time period of the field.

After the Directory Record, there are NFIELDS fields. The first record of each field is a Field Documentation Record which is followed by NRECS Field Data Records, one for each latitudinal row in the field. Each row consists of 28 bytes of information for each longitude or column forming a grid intersection plus 28 bytes at the end of the record (the Latitudinal Row Identifier) containing the row number identification and the date and time of the last analysis made for the field.

Prior to Nov. 1, 1984, a 500-km gridded SST (Climatic-Scale Analysis) product was generated and included with the 50-km gridded fields on the monthly tape. This tape contained five files, the first being the Header File previously described in Table 5.2-1. The second file contained 36 500-km daily fields organized chronologically. The 500-km fields contained 72 grid intersections in each row, one for each 5 degrees of longitude from -180W eastward to 175E. The first physical record of the second file was the Directory Record which pointed to the beginning address of each of the 36 fields. Each field consisted of 30 logical records of 2044 bytes each, blocked into five 12,264-byte physical records. Since there were 36 fields, the data spanned slightly more than a month. The third, fourth, and fifth files of this tape (prior to Nov. 1, 1984), contained 50-km gridded SST fields. The October 1984 archive tape was the last tape to contain a file of 500-km fields.

The third file of the 50-km and 500-km tape (second file after October 1984) contained the 50-km field data for Region 1 from 5N through 53N by -100W through -52W in five weekly fields organized chronologically. The first physical record of the third file was the Directory Record which pointed to the beginning of each of the five fields. Each field had 98 logical records of 2,744 bytes each, blocked into physical records of 10,976 bytes. There were 491 logical records blocked into 123 physical records in this file. The fourth and fifth files (third and fourth after October 1984) contained the 50-km gridded fields for Regions 2 and 3, covered by 15N through 63N by -145W through -97W, and 15N through 63N by 170E through -142W, respectively. They were identical to the third file in organization, but differed in the number and size of records in each file. The third file contained a region with 97 grid intersections per row, one for each .5 degrees of longitude from -100W eastward to -52W. Similarly, the fourth and fifth files had the same number of grid intersections per row, but different longitude ranges from -150W to -70W and 155E to -142W, respectively. The fourth file had five fields with each field having 62 logical records of 4,536 bytes and the fifth file had 5 fields with each field having 62 logical records of 3,416 bytes.

Before April 2, 1996, the 50-km gridded SST files were archived to tape twice each month. Beginning April 2, 1996, these 50 km gridded SST field accumulation files are archived to tape once a month (on the second day of each month) for the previous month and the field accumulation files have been enlarged. File 1 remains a header file while files 2-6 continue to contain the field files. Each field file contains 10 fields (instead of 5) which results in an increase in the number of records in each file. These fields are produced twice a week by analyzing all the SST observations obtained since the last analysis. Prior to Aug. 1, 1986, the 50-km gridded fields were generated for three regions with grid points at every .5 degree latitude/longitude intersection as described above. After Aug. 1, 1986, they were produced for five regions which are defined in Table 5.2.1-1.

Table 5.2.1-1. Areas of 50-km Gridded SST Fields after August 1, 1986.

Region 1:	5N through 53N latitude
	-100W through -52W longitude
Region 2:	15N through 63N latitude
	-145W through -97W longitude
Region 3:	15N through 63N latitude
	+170E through -142W longitude
Region 4:	-35S through 20N latitude
	-150W through -70W longitude
Region 5:	-35S through 20N latitude
	+155E through -145W longitude

The 50-km gridded SST product (after Aug. 1, 1986) contains six files. The first file is the Header File, and files 2 through 6 contain 50-km fields for Regions 1 through 5, respectively. These files are organized in the same manner as the 50-km gridded fields for three regions as previously described.

Before March 2, 1996, the 100-km SST field has the following structure. There are two files, the first being the Header File. In File 2, after the Directory Record, there are 20 fields, 142 physical records per field. The Field Documentation Record is followed by 141 Field Data Records, one for each 1 degree latitudinal row from -70S to 70N. There are 360 grid intersections in each row, one for each l degree of longitude from -180W eastward to 179E. Currently, each Field Data Record contains 2841 logical records with a maximum of 30,520 bytes.

Beginning March 2, 1996, the 100-km SST field tape is generated monthly (on the second day of the month). The tape still contains two files: file 1 is a header file, file 2 is an archive of the 100-km SST field accumulation file. However, file 2 contains 35 fields, but continues to have the same file organization as before (i.e., the directory record structure, the file record length and the format of each field have not changed). Only the number of fields and therefore the number of records in file 2 has increased.

The 14-km gridded SST fields (Local-Scale Analyses) are archived monthly on two tapes. There are eight 0.125 degree resolution fields over the areas shown in Table 5.2.1-2.

Table 5.2.1-2. Areas of 14-km Gridded SST Fields	
Region 2:	18N through 31N latitude
	-98W through -80W longitude
Region 4:	39N through 52N latitude
	-136W through -123W longitude
Region 5:	28N through 41N latitude
	+114W through -136W longitude
Region 6:	30N through 46N latitude
	-82W through -60W longitude
Region 7:	18N through 32N latitude
	-85W through -70W longitude
Region 10:	50N through 62N latitude (Seasonal)
	-160W through -126W longitude
Region 11:	50N through 70N latitude (Seasonal)
	-180W through -157W longitude
Region 12:	20N through 32N latitude
	-136W through -105W longitude

The first tape of the 14-km gridded SST field data contains Regions 2, 4, 5, 6, and 7 which cover the Gulf of Mexico, Northwest Pacific coast, Southwest Pacific coast, Northeast Atlantic coast, and Southeast Atlantic coast, respectively. This tape contains six files, the first file being the Header File. The second file contains the 14-km field data for Region 2. There are twelve weekly fields organized chronologically. The first record of each field data file is a Directory Record which points to the beginning of each of the twelve fields. Each field consists of 1273 logical records of 4060 bytes blocked into 12,180-byte physical records. There are 1,273 logical records blocked into 426 physical records in this file. The third file contains 14-km field data for Region 4. Each field in the third file consists of 1,273 logical records of 2,968 bytes blocked into 11,872-byte physical records. There are a total of 1,273 logical records blocked into 321 physical records in the file. The fourth file contains 14-km field data for Region 5. Each field consists of 1,273 logical records of 4,984 bytes blocked into 9,968-byte physical records. There are 1,273 logical records blocked into 640 physical records in this file. The fifth file contains 14-km field data for Region 6. Each field consists of 1,561 logical records of 4,984 bytes blocked into 9,968-byte physical records. There are a total of 1,561 logical records blocked into 784 physical records in this file. The sixth file contains 14-km field data for Region 7. Each field consists of 1,369 logical records of 3,416 bytes blocked into 10,248-byte physical records. There are a total of 1,369 logical records blocked into 460 physical records in this file.

The second tape of the 14-km gridded SST data contains Regions 10, 11 and 12 which cover the Gulf of Alaska, Bering Sea and the Gulf of California, respectively. This tape contains four files, the first file being the Header File which has already been described. The second file contains the 14-km field data for Region 10. This file contains twelve weekly fields organized chronologically. The first record in each field data file is a Directory Record which points to the beginning of each of the twelve fields. Each field consists of 1,177 records of 7,672 bytes each. The third file contains 14-km field data for Region 11 and has the same format as the second file except each field consists of 1,945 records of 5,208 bytes each. The fourth and file contains 14-km data for Region and is identical to the second file in organization except the record size is 7,000 bytes.

5.2.1.1 Directory Record Format

A Directory Record is always the first record of each SST Field File (except the Header File). It has a variable length with zero fill to the logical record size of the type of field, and serves as a pointer to the beginning of each field. Table 5.2.1.1-1 contains the format of the Directory Record.

Table 5.2.1.1-1. Format of the Directory Record for the SST Field File.

Full Word #	Content
1	Number of records in the data set
2	Number of records in each field (NRECS)
3	Number of fields in the accumulation file (NFIELDS)
4	Field number of latest field entered in accumulation file
5	Record number of first record of Field #1
6	Record number of first record of Field #2
...	...
4+NFIELDS	Record number of first record of Field # NFIELDS

5.2.1.2 Field Documentation Record

The format of the Field Documentation Record is described in Table 5.2.1.2-1. There are 158 words of information in the Field Documentation Record with blank fill to the logical record size of the particular kind of field. The minimum size is 158 words (632 bytes) and the maximum size is 2,527 words (10,108 bytes). It has the following format (where R or I indicates real or integer words, respectively):

Table 5.2.1.2-1. Format of the Field Documentation Record.

Word #	Parameter	R or I	Description
1	LDBGN	I	Record number of the first row of the field (currently 2 for all fields since the documentation record requires only one record).
2	SMGLAT	R	Minimum latitude included in field which is the bottom edge and first row of field (-South; + North).
3	AXLAT	R	Maximum latitude included in field which is the top edge and last row of field (-South; + North).
4	SMLONG	R	Minimum longitude included in field which is the left edge and first column of field (-West; + East).
5	AXLONG	R	Maximum longitude included in field which is the right edge and last column of field (excluding the I.D. column) (-West;+East).
6	RES	R	Number of latitude-longitude degrees between each grid point.
7	SMHOUR	R	Youngest time, in hours of the year, of observations used during last analysis, which becomes the oldest time allowed for the next analysis.
8	HOURS	R	Oldest time, in hours of the year, of observations used during last analysis.
9	TIMGAP	R	Number of hours between youngest and oldest times of observations used in analysis.
10	MAXDAT	I	Maximum number of hours allowed in time period for observation times to be included in analysis.
11	SMREL	R	Minimum reliability of observations to be used in analysis.
12	AXREL	R	Maximum reliability of observations to be used in analysis.
13-22	SORC(10)	R	List of source codes of observations to be used in analysis. (See Table 5.2.2.1-6)
23-32	OBTYPE (10)	R	List of observation types allowed to be used in analysis. (See Table 5.2.2.1-5)
33	NROWS	I	Number of rows (latitudinal parallels) included in field, excluding documentation record.
34	NCOLS	I	Number of columns (longitudinal meridians) in field, including the I.D. column.

35	IBLK	I	Number of rows or logical records per physical block.
36	NWRDS	I	Number of full words (32 bits) allocated to each grid point.
37	ISZ	I	Number of rows to be maintained in an array in core for temperature analysis and calculation of gradients.
38	ICENT	I	Center line within the array of ISZ rows upon which calculations will be performed.
39-41	LWT, LNT, LBT	I	Word number, length in bits, and starting bit location of analysis temperature within a grid intersection information unit of an SST field.
42-44	LWG, LNG,LBG	I	Word number, length in bits, and starting bit location of average gradient.
45-47	LWGXP, LNGXP, LBGXP	I	Word number, length in bits, and starting LBGXP bit location of gradient X+ direction.
48-50	LWGXN, LNGXN, LBGXN	I	Word number, length of bits, and starting LBGXN bit location of gradient X- direction.
51-53	LWGYP, LNGYP, LBGYP	I	Word number, length in bits, and starting LBGYP bit location of gradient Y+ direction.
54-56	LWGYN, LNGYN, LBGYN	I	Word number, length in bits, and starting LBGYN bit location of gradient Y- direction.
57-59	LWPD, LNPD, LBPD	I	Word number, length in bits, and starting LBPD bit location of Physiographic Description.
60-62	LWNO, LNNO, LBNO	I	Word number, length in bits, and starting LBNO bit location of Number Observations.
63-65	LWAGE, LNAGE, LBAGE	I	Word number, length in bits, and starting LBAGE bit location of Age of most Recent Observations.
66-68	LWREL, LNREL, LBREL	I	Word number, length in bits, and starting LBREL bit location of Reliability.

69-71	LWCLS, LNCLS, LBCLS	I	Word number, length in bits, and starting LBCLS bit location of Class 1 coverage.
72-74	LWSXP, LNSXP, LBSXP	I	Word number, length in bits, and starting LBSXP bit location of Spatial Covariance X+.
75-77	LWSXN, LNSXN, LBSXN	I	Word number, length in bits, and starting LBSXN bit location of Spatial Covariance X-.
78-80	LWSYP, LNSYP, LBSYP	I	Word number, length in bits, and starting LBSYP bit location of Spatial Covariance Y+.
81-83	LWSYN, LNSYN, LBSYN	I	Word number, length of bits, and starting LBSYN bit location of Spatial Covariance Y-.
84-86	LWIND, LNIND, LBIND	I	Word number, length in bits, and starting LBIND bit location of Independent Temperature.
87-96	GRDWTS (10)	R	Weight assigned to each grid unit, according to its distance from the grid intersection for which gradients are being calculated.
97	NP	I	Number of grid points to be used in calculation of gradients.
98-117	KMDST (10,2)	I	Look up table of gradient values and corresponding distances to be used in determining the search area for analysis.
118	MKM	R	Number of paired entries in KMDST.
119-138	H(10,2)	R	Look up table of gradient values and corresponding factors to be used in determining the new weight assigned to the observation temperature analysis.
139	MH	I	Number of paired entries in H.
140	EXP	R	Exponent used in temperature analysis.
141	FDX	R	Factor used in determining new weight assigned to the observation temperature for analysis.
142	XCLASS	R	Factor used to place gradients into a class for Gradient Class Summary.

143	DEL	R	Maximum number of degrees Centigrade (x 10) that the new analysis temperature may differ from the previous SST field temperature.
144	MF	I	Factor applied to the previous field temperature and reliability to determine the final analysis temperature and its reliability.
145	MSTAR	I	Factor applied to the combined observation temperature and weight in determining the new analysis temperature.
146	MNSRCH	I	Minimum distance in kilometers to be searched for analysis observations.
147	MXSRCH	I	Maximum distance in kilometers to be searched for analysis observations.
148	BDEL	R	Maximum distance in kilometers to be searched for analysis observations. Maximum difference allowed between new analysis temperature and the previous one for Class 1 coverage bit to be set to 1.
149	FCWT	R	Maximum value that can be assigned as the reliability of the new analysis temperature.
150	IYYY	I	Year of youngest time of observation data used (0-99).
151	IYMM	I	Month of youngest time of observation data used (1-12).
152	IYDD	I	Day of youngest time of observation data used (1-31).
153	IYHH	I	Hour of youngest time of observation data used (0-23).
154	IOYY	I	Year of oldest time of observation data used (0-99).
155	IOMM	I	Month of oldest time of observation data used (1-12).
156	IODD	I	Day of oldest time of observation data used (1-31).
157	IOHH	I	Hour of oldest time of observation data used (0-23).
158	ICURTM	I	Last time used in analysis (in Julian days from Jan. 1, 4713 BC).

5.2.1.3 Field Data Record Format

Each Field Data Record (latitudinal row) consists of a series of grid intersection points. These points are 28 bytes in length. Each longitude (column) reflects one grid intersection. At the end of the data record (i.e., immediately following the last column) is the 28-byte Latitudinal Row Identifier. All parameters in the grid intersection are stored as integer values and have the format shown in Table 5.2.1.3-1. Note: climatology values are available in global SST fields only.

Table 5.2.1.3-1. Format of the Parameters in the Grid Intersection.				
Word #	**Byte #**	**Description**	**Units**	**Range**
1	1-2	Analysis Temperature	C x 10	-850 to +610
1	3-4	Average Gradient	C/100 km (x 10)	0 to 300
2	5-6	Gradient X+	C/100 km (x 10)	0 to 300
2	7-8	Gradient X-	C/100 km (x 10)	0 to 300
3	9-10	Gradient Y+	C/100 km (x 10)	0 to 300
3	11-12	Gradient Y-	C/100 km (x 10)	0 to 300
4	13	Physiographic Descriptor	0 = sea; 1=land	0 to 15
4	14	Spare	Undefined	Blank
4	15	Number of Observations	Integer	0 to 255
4	16	Age Recent Observations	Hours	0 to 255
5	17-18	Reliability	Integer	0 to 32767
5	19-20	Class 1 Coverage	Bits	0 or 1
6	21	Spatial Covariance X+	Grid units	0 to 10
6	22	Spatial Covariance X-	Grid units	0 to 10
6	23	Spatial Covariance Y+	Grid units	0 to 10
6	24	Spatial Covariance Y-	Grid units	0 to 10
7	25-26	Climatological Temperature	C (x 10)	-850 to +610
7	27-28	Spare	Undefined	Blank

The format of the Latitudinal Row Identifier (last 28 bytes of a row) is contained in Table 5.2.1.3-2. All parameters in the table are stored as integer values. Words 5 through 7 are the date and time at which analysis was performed.

Table 5.2.1.3-2. Format of the Latitudinal Row Identifier				
Word #	**# Bytes**	**Description**	**Units**	**Range**
1	4	Row	Integer	1-141
2	4	Spare	Undefined	0 to 2^{32}
3	4	Spare	Undefined	0 to 2^{32}

4	1	Physiographic Descriptor	Integer	Always 255
4	3	Spare	Undefined	0 to 2^{24}
Date and time at which analysis was performed:				
5	4	Hour of Day, Minutes of hour	100 x hours + minutes	100 x (0-23) + (0-59)
6	4	Day of Year	Days	1-366
7	4	Year (2-digit)	Years	0-99

The terms used to describe the grid intersection points are defined as follows:

ANALYSIS TEMPERATURE - The latest sea surface temperature calculated based on the previous analysis temperature, weighted according to its reliability combined with a weighted average of current observations within a surrounding area which is determined according to the grid points gradient.

AVERAGE GRADIENT - The average of the gradients in all four directions (N, S, E, W) from the grid intersection.

GRADIENT IN X+ DIRECTION - Change in temperature between the grid point and neighbor points within the field in the positive direction along the X axis.

GRADIENT IN X- DIRECTION - Change in temperature in the negative direction along the X axis.

GRADIENT IN Y+ DIRECTION - Change in temperature in the positive direction along the Y axis.

GRADIENT IN Y- DIRECTION - Change in temperature in the negative direction along the Y axis.

PHYSIOGRAPHIC DESCRIPTOR - The land/sea tag indicating whether a grid intersection is a land or sea point.

SPARE - Unused parameter.

NUMBER OF OBSERVATIONS - The total number of current observations used in the analysis of the new temperature for the grid intersection.

AGE OF MOST RECENT OBSERVATION - The age, in hours from the time of last analysis, of the most recent observation used to determine the new temperature for a grid intersection.

RELIABILITY - New reliability associated with the new temperature, based on the previous reliability combined with the weighted reliability of all observations used in the last analysis. Larger values are more reliable.

CLASS 1 TEMPORAL COVERAGE - Set of bits (0-15) of which Bit 1 is set to 1 for each analysis which included observations with a reliability greater than or equal to a specific minimum reliability considered as Class 1. Bit 0 always remains a 0, and all bits are shifted right during each analysis leaving Bit 1 to 0 when no Class 1 reliability observations are used for a grid intersection.

SPATIAL COVARIANCE X+ - The distance in grid units from the grid intersection to the nearest land mass in the positive direction along the X axis.

SPATIAL COVARIANCE X- - The distance in grid units from the grid intersection to the nearest land mass in the negative direction along the X axis.

SPATIAL COVARIANCE Y+ - The distance in grid units from the grid intersection to the nearest land mass in the positive direction along the Y axis.

SPATIAL COVARIANCE Y- - The distance in grid units from the grid intersection to the nearest land mass in the negative direction along the Y axis.

CLIMATOLOGICAL GRID TEMPERATURE - The average sea surface temperature of a grid intersection for a particular month over a number of years, taken from the global climatology file (for global field files only).

5.2.2 **SST Observation File**

There has been a steady evolution of the SST Observation file since it was first generated in December 1978 using TIROS-N data. In 1978, the SST Observation file contained seven days of SST data at a resolution of 50 km. On Nov. 17, 1981, the operational technique for calculating SSTs was changed to a multichannel technique with separate algorithms for day and night observations. This new multichannel technique yielded a much improved resolution of 8 km. On Nov. 1, 1986, the SST Observation File was changed to eight days to satisfy requirements for the Tropical Ocean and Global Atmosphere (TOGA) project. The basic structure of the two types of SST Observation Files is very similar. However, there are differences in the format of the Block Directory, Subblock Directory, and the Observation Unit. Section 5.2.2.1 describes the Seven Day Observation File and Section 5.2.2.2 describes the Eight Day Observation File.

The SST Observation File contains either seven or eight days of SST observations (depending on time period of data) which are organized in 5 x 5 degree blocks. These 5 x 5 degree blocks are further subdivided into 1 x 1 degree subblocks. Global coverage requires 2,592 blocks. The block number IBLOCK for an observation located at ILAT latitude (+N,-S) and ILONG longitude (+E,-W) can be calculated using the following equation:

$$IBLOCK = \frac{(ILAT - LA)}{LAO} \times INBC + \frac{(ILONG - LO)}{LOO} + 1 \qquad 5.2.2\text{-}1$$

where LA is the latitude origin of the file (-90 degrees), LO is the longitude origin of the file (-180 degrees), LAO is the size of the block in the latitudinal direction (5 degrees), LOO is the size of the block in the longitudinal direction (5 degrees), and INBC is the number of column blocks (360 degrees/LOO). Each block includes the minimum whole latitude and longitude, and excludes the maximum whole latitude and longitude which borders the block. For example, the limits of Block 1 are: -90.0S to -85.01S and -180.0W to -175.01W. Since all subblocks are 1 degree boxes, the Subblock number SBN for a given latitude and longitude can be defined as:

$$SBN = (ILAT - LLA) \times ILONG - LLL + 1 \qquad 5.2.2\text{-}2$$

where LLA and LLL are respectively the lower left latitude and longitude of the 5 degree block.

On July 26, 1995, NESDIS began archiving an 8-day observation file created from SST retrievals processed at the Naval Oceanographic Center at Stennis Space Center, MS. This was initiated under a Department of Commerce/Department of Defense agreement for shared processing. This file is identical in format to the NESDIS 8-day observation file.

5.2.2.1 **Seven Day SST Observation File**

The Seven Day SST Observation File is organized with the first record containing documentation and directory information. This Block Directory Record points to the location of the beginning record for each block in the file. The first record in each block contains a Subblock directory. The Subblock Directories point to the first Observation Unit (6 words) in each of 25 subblocks for each block. The structure of the SST Observation File is shown in Figure 5.2.2.1-1.

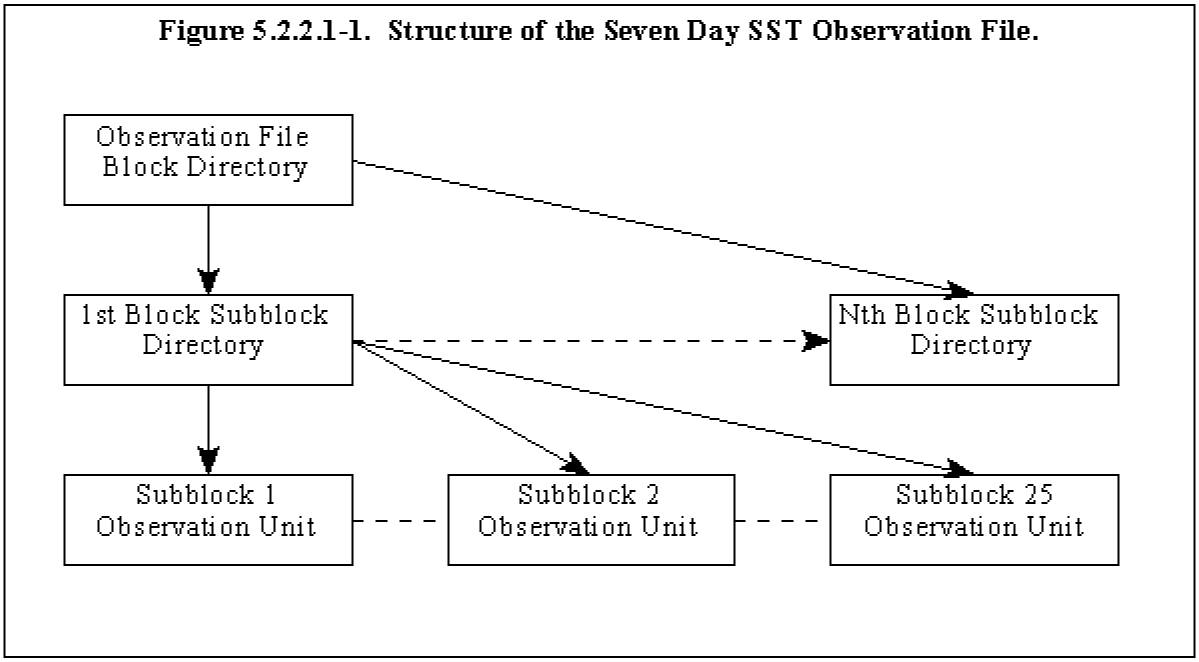

Figure 5.2.2.1-1 Structure of the Seven Day SST Observation File

The first record in the SST Observation File is the Block Directory and it contains 13,024 bytes. The Block Directory contains location information, dates of data, and pointers to the location of the beginning record for each block. The format of the Block Directory for the Seven Day SST Observation File is contained in Table 5.2.2.1-1.

Table 5.2.2.1-1. Format of the Block Directory for the Seven Day SST Observation File.

Halfword #	Contents
1	LA, the latitude origin of the file
2	LO, the longitude origin of the file
3	LAO, size of block in latitudinal direction
4	LOO, size of block in longitudinal direction
5	First free record pointer
6	Number of records in file
7	Start of Block Directory Information (in halfwords)
8	Day of year of most recent information
9	Year of most recent information

10	NESDIS archive flag (1 if archived; 0 if not archived) of most recent information
11-13	Day of year, year, NESDIS flag of 2nd most recent data
14-16	Day of year, year, NESDIS flag of 3rd most recent data
17-19	Day of year, year, NESDIS flag of 4th most recent data
20-22	Day of year, year, NESDIS flag of 5th most recent data
23-25	Day of year, year, NESDIS flag of 6th most recent data
26-28	Day of year, year, NESDIS flag of 7th most recent data
29-31	Day of year, year, NESDIS flag of 8th most recent data
32-40	Unused
41	Record position for block 1 (zero if no data in block)
42	Record position for block 2 (zero if no data in block)
...	...

Under normal circumstances, there can be a maximum of 3,250 blocks. The remaining records in the SST Observation File contain the Subblock Directories and Observation Units. The format for the Subblock Directory is contained in Table 5.2.2.1-2.

Table 5.2.2.1-2. Format of the Subblock Directory

	Halfword #	Byte #	Contents
	1	1	Record number
	2	3	Block number
	3	5	Pointer (in halfwords) to start position of Subblock directory information
	4	7	Length of observation unit in words (normally 6 words)
	5	9	LLA, lower left latitude of block
	6	11	LLL, lower left longitude of block
	7	13	Pointer (in halfwords) for start of observation data
	8	15	Unused

Repeated for rest of Subblocks	9	17	Position (in halfwords) for start of Subblock 1 Observation Units
	10	19	Position for end of Subblock 1 Observation Units
	11	21	Record number containing Subblock 1
...	...	...	...

There is only one Subblock Directory for each block. It is not repeated at the start of each new record. If no data is contained in a Subblock, then all corresponding location parameters are set to zero. All unused bytes in each record are set to zero.

The Observation Unit contains the actual SST data for each Subblock. Each unit contains 6 words and has the format shown in Table 5.2.2.1-3. The first bit in the Observation Unit must be on as this signifies the beginning of the unit. Thus, the type of observation is coded in one byte as a number between 129 and 255. Also, there cannot be a high order bit on in any odd full word of the unit because it will be interpreted as the beginning of a unit. Note: in this format a longitude value of +180 degrees is not allowed and a value of -3000 for temperature signifies no information.

Table 5.2.2.1-3. Format of the Observation Unit.

Halfword #	Byte #	Content	Range
1	1	Type of observation (see Table 5.2.2.1-5)	129-255
1	2	Source of observation (see Table 5.2.2.1-6)	0-255
2	3	Year of century (last 2 digits)	0-99
2	4	Month of year	1-12
3	5-6	Latitude (+N, -S) x 100	-9000 to 9000
4	7-8	Longitude (+E, -W) x 100	-18000 to 17999
5	9	Day of month	1-31
5	10	Hour	0-23
6	11	Minute	0-59
6	12	Second	0-59
7	13-14	SST Measurement (degrees C x 10)	-3000 to 1000
8	15-16	Reliability	Variable (normal=100)

9-12	17-24	Variable information (depending on observation type)	n/a

The record structure of the Seven Day SST Observation File is contained in Table 5.2.2.1-4 (assuming that data for 25 subblocks can be stored in one record). If there are no data in a block, there will be no record for that block. If there are numerous data for a block, there will be more than one consecutive record allocated to that block. Note: Currently, the SST Observation File has a maximum of 4,002 records.

Table 5.2.2.1-4. Record structure of the Seven Day SST Observation File.

Record #	Contents
1	Block Directory
2	1st block, Subblock directory and data for 25 subblocks
3	2nd block, Subblock directory and data for 25 subblocks
...	**...**
2593	2592nd block, Subblock directory and data for 25 subblocks

Tables 5.2.2.1-5 and 5.2.2.1-6 contain the SST Observation types and source codes, respectively.

Table 5.2.2.1-5. SST Observation Types.

Code	Type
0	No type
1-128	Illegal type code
129	Nominal SST
130	AVHRR only SST
131	HIRS/2 only SST
132	Coastal type
133	Reserved
134	Reserved
135	Reserved
136	Reserved
137	Reserved

138	Test type
139-149	Reserved
150	Heat Budget observation
151	AVHRR-only day operational
152	AVHRR-only night operational
153	HIRS-only day operational
154	HIRS-only night operational
155	AVHRR + HIRS day operational
156	AVHRR + HIRS night operational
157	Reserved
158	Aerosol contaminated night operational
159	Reserved
160	Reserved
161	AVHRR-only day test
162	AVHRR-only night test
163	HIRS-only day test
164	HIRS-only night test
165	AVHRR + HIRS day test
166	AVHRR + HIRS night test
167-168	Reserved
179	ITOS SST
180-199	Reserved
200	Independent SST (Ship or Buoy)
201-254	Reserved
255	Erroneous Data - Do not use this Observation
Note: Codes having values between 0 and 149 (inclusive) indicate the operational technique in use between Dec. 1, 1978 and Nov. 16, 1981. Codes having values between 150 and 166 (inclusive) indicate a multichannel technique in use between Nov. 17, 1981 and the present.	

Table 5.2.2.1-6. SST Observation Source Codes

Source code (archived data)	Source
128	No source
129	AVHRR #1 (TIROS-N)
130	AVHRR #2 (NOAA-6)
131	AVHRR #3 Not used
132	AVHRR #4 (NOAA-7)
133	AVHRR #5 Not used
134	AVHRR #6 (NOAA-8) [1]
135, 7[2]	AVHRR #7 (NOAA-9)
8	AVHRR #8 (NOAA-10) [1]
1	AVHRR #9 (NOAA-11)
5	AVHRR #10 (NOAA-12)
2	AVHRR #11 (NOAA-13) [3]
3	AVHRR #12 (NOAA-14)
TBD	AVHRR #15-20 (TBD)
21-50	ITOS NOAA-1 Sensor #1
51	ITOS NOAA-1 Sensor #2
53	ITOS NOAA-2 Sensor #1
54	ITOS NOAA-2 Sensor #2
55-58	ITOS NOAA-3 and -4
59-62	ITOS NOAA-5
63-127	Reserved

[1] No SSTs were archived for these satellites.
[2] NOAA-9 source code was 135 prior to August 4, 1986. NOAA-9 source code was 7 beginning on August 4, 1986.
[3] No SSTs were ever produced for this satellite.

5.2.2.2 **Eight Day SST Observation**

The Eight Day SST Observation File is arranged similarly to the Seven Day Observation File (see Fig. 5.2.2.1-1). Currently, it has 5 x 5 degree blocks, which are further subdivided into 1 x 1 degree subblocks. There are 25 subblocks in each block. The first record in the Eight Day SST Observation File is the Block Directory which contains 13,028 bytes using the record format VS option. The format of the Block Directory is contained in Table 5.2.2.2-1.

Table 5.2.2.2-1. Format of the Block Directory Record.

Halfword #	Contents
1	LA, the latitude origin of the file (range: -90 to 90)
2	LO, the longitude origin of the file (range: -180 to 180)
3	LAO, size of block in latitudinal direction (range: 1 to +5)
4	LOO, size of block in longitudinal direction (range: 1 to +5)
5	First free record pointer (points to record number of 1st record available as an overflow track; 0 if no more tracks available).
6	Number of records in file (3100 initially)
7	Start of Block Directory Information in halfwords (11 initially)
8	Day of year of most recent information (range: 1 to 366)
9	File availability: 0=available; 1=unavailable, update in progress
10	Year of century of last data (range: 0 to 99)
11	Record number for Block 1 (range: 2 to 3100; 0 for no data in block)
12	Record number for Block 2 (range: 2 to 3100; 0 for no data in block)
...	...

Using the block number, the record number can be calculated and found in the portion of the Block Directory which serves as a lookup table. If the record number entry is zero, there is no data for that corresponding block in the file. The record number points to the Observation Data record, of which the first portion is a subdirectory. The file contains 8,446 records of 13,028 bytes each. The Observation Data record has the format shown in Table 5.2.2.2-2.

Table 5.2.2.2-2. Format of Observation Data Record

Halfword #	Contents	Range
1	Record number	2 to 4002

2	Block number	1 to 2592
3	Extent number (number of records removed from primary)	0 (if primary)
4	Pointer to succeeding overflow record. Last overflow record points to primary record.	0 if no overflow
5	Pointer to halfword position of start of Observation Unit	61
6	Pointer to start of Subblock Directory	11
7	Lower left latitude of block LLA (+N,-S) in degrees	-90 to +90
8	Lower left longitude of block LLL (+E,-W) in degrees	-180 to +180
9	Pointer to last halfword containing data	n/a
10	Unused	n/a
11	Halfword of start of data for Subblock #1	0 if no data
12	Halfword of end of data for Subblock #1 (other extents may or may not contain data for this Subblock).	0 if no data
13-60	Similar to halfwords # 11 and #12 for remaining subblocks	n/a
61-6512	Observation Unit	n/a

If the block size is changed in the future, a block may contain a different number of subblocks, thus changing the number of Subblock pointers and the starting halfword of the Observation Unit. If the observations for a block do not fit on one record, then as many records (extents) are allocated as needed. Each additional record will include the subdirectory and Observation Unit. If the Subblock contains no information, then the start and end position contain a zero. Subblocks may cross record boundaries. If an entire Subblock cannot fit into one record, it will be split and a new record will be allocated for the remainder of the Subblock. Unused portions of records and records containing no data will be zero filled.

The Observation Unit for the Eight Day SST Observation File is of variable length, ranging from a minimum of 4 words to a maximum of 24 words. The length must be an even number of full words with no odd full word (except the first word which is always negative). The first three words of an Observation Unit contain identification information including the type of algorithm used, the satellite, date, time, and location. The fourth word contains the actual SST data and the reliability assigned to the observation. The remainder of the Observation Unit is unique to the type of algorithm used. The format of the Eight Day SST Observation Unit is contained in Table 5.2.2.2-3.

Table 5.2.2.2-3. Format of the Eight Day SST Observation Unit.

Halfword #	Byte #	Contents	Range
1	1	Type of Observation (Table 5.2.2.1-5)	129 to 255
1	2	Source of Observation (Table 5.2.2.1-6)	0 to 255
2	3	Year	0 to 99
2	4	Month	1 to 12
3	5-6	Latitude (+N,-S) x 100	-9000 to 9000
4	7-8	Longitude (+E, -W) x 100	-18000 to 17999
5	9	Day	1 to 31
5	10	Hour	0 to 23
6	11	Minute	0 to 59
6	12	Second	0 to 59
7	13-14	SST (degrees C x 10)	-20 to 350
8	15-16	Reliability	0 to 32767
9	17-18	Solar Zenith Angle (degrees x 10)	0 to 1800
10	19-20	Satellite Zenith Angle (degrees x 100)	-600 to 600
11	21-22	Analyzed Field SST (degrees C x 10)	-20 to 350
12	23-24	Internal Error (RMS x 100)	0 to 1000
13	25-26	Solar azimuth angle (degrees x 10)	0 to 1800
14	27-28	Climatological SST (degrees C x 10)	-20 to 350
15	29	Beginning Row if unit array	1 to 11
15	30	Beginning Column of unit array	1 to 11
16	31-32	AVHRR Channel 1 average (% x 100)	0 to 10000
17	33-34	AVHRR Channel 2 average (% x 100)	0 to 10000
18	35-36	AVHRR Channel 3 average (K x 100)	0 to 32767
19	37-38	AVHRR Channel 4 average (K x 100)	0 to 32767
20	39-40	AVHRR Channel 5 average (K x 100)	0 to 32767
21	41-42	Space view σ Channel 1 (% x 100)	0 to 10000

22	43-44	Space view σ Channel 2 (% x 100)	0 to 10000
23	45-46	Space view σ Channel 3 (K x 100)	0 to 32767
24	47-48	Channel 4 Blackbody Temperature (K x 100)	0 to 32767
25	49-50	Channel 5 Blackbody Temperature (K x 100)	0 to 32767
26	51-52	Year of observation[1]	1998 to 32767
27	53-56	Spares	n/a
[1] This change makes the software Year 2000 compliant with a 4-digit year. Change went into effect on 4/29/98 with the 12Z NOAA-14 GAC orbit.			

5.2.3 **SST Monthly Mean Archive**

The SST Monthly Mean Archive contains 12 monthly mean SST fields for one year. NESDIS creates this archive tape in January of every year, archiving the monthly mean fields for the previous year. The data on this tape were derived exclusively from satellite data. The field has a 2.5 degree latitude-longitude resolution or 250-km resolution. For each 2.5 degree box in the field, there is a count of the number of observations in the box, the mean SST, and the standard deviation about the mean, σ.

The SST Monthly Mean archive tape contains two files. The first file is a Header File (previously described in Section 5.2) which contains information about the data on tape. The second file has 72 physical records, each containing 12 logical records consisting of satellite SST monthly mean data. For each month of the year and for each point of its geographical grid, the data consists of 1) the month's mean temperature, T; 2) the standard deviation of a single measure, σ_T ; and 3) the number of observations entering into the mean, N. Each of these quantities are stored as 2-byte integers: T as degrees C x 10, σ_T as degrees C x 100 and N as itself.

The geographical grid establishes a global field of boxes at 2.5 degree resolution. Boxes are bordered by meridians and parallels which are multiples of 2.5 degrees in latitude and longitude. Four of these boxes can be combined to produce boxes centered on intersections of meridians and parallels which are multiples of 5 degrees in latitude and longitude.

The second file contains 12 fields, the first is January, the last is December. Each field has 72 logical records grouped into 12 logical records per physical record or each field has 6 physical records. Each logical record is 876 bytes long with 10,512 bytes in a physical record. The first logical record in each field contains data for the 2.5 degree latitude band with southern boundary at 90.0S. The 72nd logical record for a field has data for the 2.5 degree latitude band with southern boundary at 87.5N. Within a latitude band, the first grid box has a westernmost boundary of 180W. The 144th grid box has a westernmost boundary of 177.5E. Each grid box requires three 16-bit halfwords. In addition, the first 12 bytes of each logical record contains the year, month, and latitude of the latitude band. A detailed format description of a Monthly Mean Data Field is contained in Table 5.2.3-1.

Table 5.2.3-1. Format of Monthly Mean Data Field		
Logical Record #	**Bytes**	**Content (Integer values indicated)**
1	1-4	Year of data (e.g., 1978)
1	5-8	Month of data (e.g., 1)
1	9-12	Latitude of southern edge of this 2.5 degree latitude band (real value)
1	13-14	Number of observations N for 2.5 degree box with southwest corner at 90.0S, 180.0W.
1	15-16	Monthly mean temperature T (degrees C x 10) for same box
1	17-18	Standard deviation σ_T (degrees C x 100) for same box
1	19-20	N for 2.5 degree box with southwest corner at 90.0S, 177.5W.
1	21-22	T for same box
1	23-24	σ_T for same box
...	...	...
1	871-872	N for 2.5 degree box with southwest corner at 90.0S, 177.5E.
1	873-874	T for same box
1	875-876	σ_T for same box
...	...	...
72	10,507-10,508	N for 2.5 degree box with southwest corner at 87.5N, 177.5E.
72	10,509-10,510	T for same box.
72	10,511-10,512	σ_T for same box.

5.3 Mapped GAC Products

The mapped GAC products consist of mapped mosaics displayed on Polar Stereographic and Mercator map projections with both forms available on CCTs. The mapped mosaics are of daytime visible (VIS) and Infrared (IR), and nighttime IR imagery. The mapped GAC product in Polar Stereographic form is described in Section 5.3.1, while the mapped GAC product in Mercator form is described in Section 5.3.2.

NESDIS/IPD produces an operational mapped GAC product which is known as the Global Vegetation Index Product. This product provides a means of monitoring the density and vigor of green vegetation over the growing areas of the Earth. Plate Carrée, Polar Stereographic and Mercator mosaics of the Global Vegetation Index, derived from AVHRR Channels 1, 2, plus coincident channels 4 and 5, and supporting information are produced weekly. For more information, contact NCDC to obtain a copy of the *NOAA Global Vegetation Index User'sGuide*.

5.3.1 Mapped GAC (Polar Stereographic) Product (1979 - Oct. 26, 1994)

Mapped GAC Product (in Polar Stereographic projection) produced between 1979 and Oct. 26, 1994 have the format described in this section. The mapped mosaics are displayed on a 1024 x 1024 Polar Stereographic grid that provides 14.8 km resolution at the Equator decreasing to 29.6 km near the poles. The mapped GAC (Polar Stereographic) product tapes have the file structure as shown in Table 5.3.1-1.

Table 5.3.1-1. File Structure of the Mapped GAC (Polar Stereographic) Tapes.

File #	Record #	Bytes/ record	Contents
1	1	4096	Northern Hemisphere IR day documentation
	2	4096	Northern Hemisphere VIS day documentation
2	1-512	4096	Northern Hemisphere IR/VIS day data (interleaved)
3	1	4096	Southern Hemisphere IR day documentation
	2	4096	Southern Hemisphere VIS documentation
4	1-512	4096	Southern Hemisphere IR/VIS day data (interleaved)
5	1	4096	Northern Hemisphere IR night documentation
6	1-256	4096	Northern Hemisphere IR night data
7	1	4096	Southern Hemisphere IR night documentation
8	1-256	4096	Southern Hemisphere IR night data

Files 2 and 4 contain IR and VIS data for both hemispheres. The 8-bit IR daytime and 8-bit VIS mapped quantities are combined into a single 16-bit quantity for each map position. The upper order 8 bits are the IR day data and the lower order 8 bits are the VIS data. This 16-bit combination gives the user a comparison of identical time views with IR and VIS data for each grid position. Each data record contains 4,096 (8-bit) bytes which holds two mapped rows. Temperature values range from 0 (warm) to 254 (cold) for IR data, and a brightness count from 0 (dark) to 254 (bright) for VIS data. A value of 255 represents no data. Figure 5.3.1-1 shows the arrangement of the data on the Polar Stereographic map base for IR day and VIS.

The format for Files 6 and 8 (which contain IR night data for both hemispheres) is similar to Files 2 and 4 except that there is only one type of data represented. Each record contains 4,096 bytes which correspond to four map rows. Each byte represents a mapped value ranging from 0 (warm) to 254 (cold). Figure 5.3.1-2 shows the arrangement of the data on the Polar Stereographic map base for IR night.

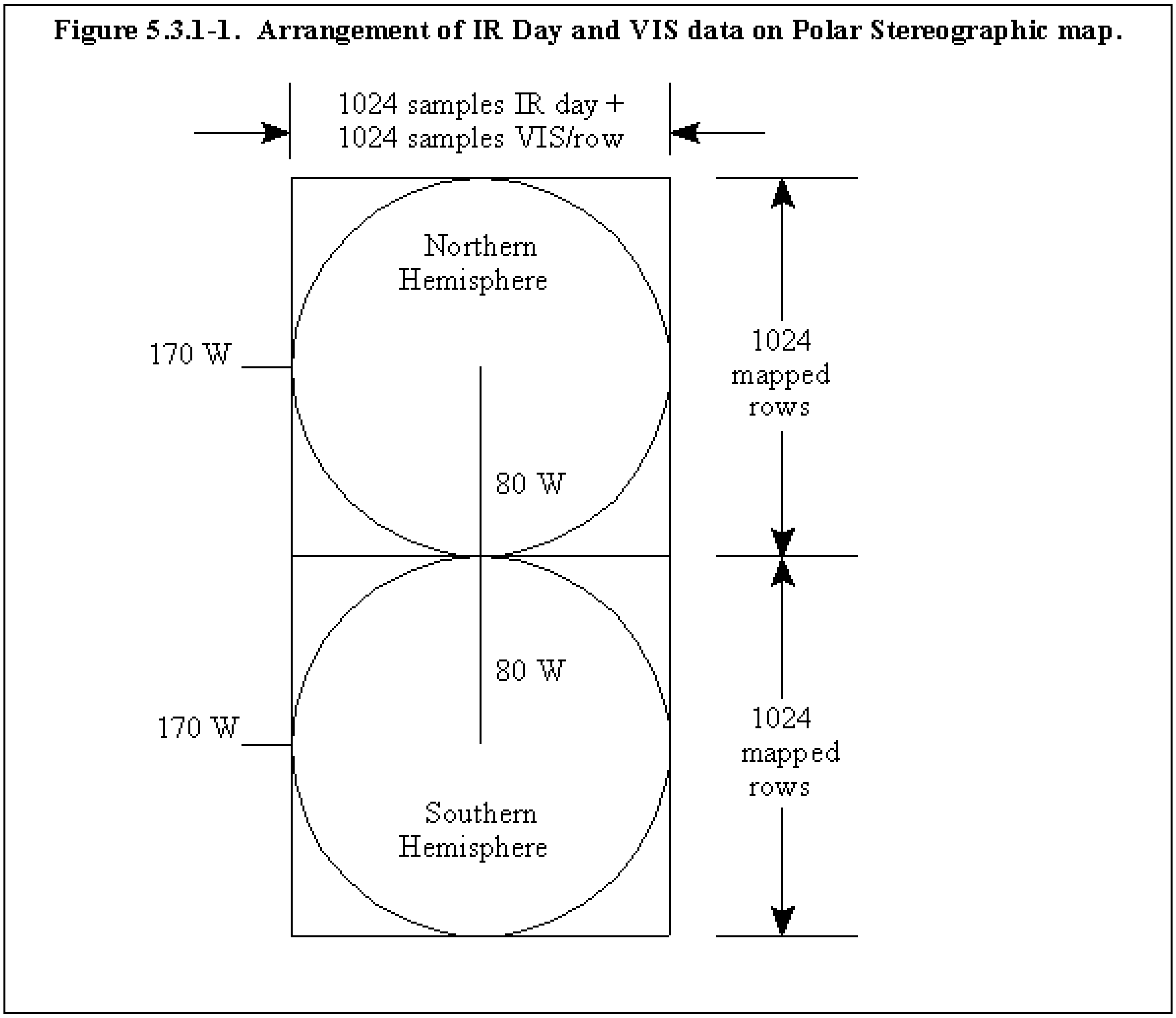

Figure 5.3.1-1. Arrangement of IR Day and VIS Data on Polar Stereographic Map.

Files 1, 3, 5, and 7 contain documentation for the data file immediately following. These documentation files contain a single 4,096 word (32-bit) record. The documentation record of each map file contains a 32-word documentation group for each of the passes mapped for a single day's archive. The first word of the record indicates the number of passes processed. The format of the documentation record is contained in Table 5.3.1-2. The time information is contained in the rightmost six-bytes of the specified two-word group. The time consists of the year, Julian day, and time of day (UTC) in milliseconds. The year is contained in the first seven bits of the first two bytes, with the nine-bit Julian day right justified in the same two bytes and the 27-bit millisecond time of day right justified in the last four bytes. All other bits are set to zero.

Table 5.3.1-2. Format of the Documentation Record.	
Word #	**Content**
1	Number of data sets processed
N	Spacecraft ID (See Section 2.0.1)
N+1	Spare
N+2 to N+3	Data set start time
N+4	Spare
N+5 to N+6	Data set end time
N+7	Spare
N+8 to N+9	Processing block ID (See Section 2.0.1)
N+10	Spare
N+11	Data type (GAC data=32)
N+12 to N+31	Spares
Note: Word numbers N through N+31 are repeated for each data set.	

The processing block ID is written in ASCII character code. The conversion table for hex to ASCII is included in Table 2.1.1-2.

It is helpful when working with Polar Stereographic maps to be able to convert from latitude and longitude to I and j coordinates or vice-versa. Two subroutines called IJTOLL and LLTOIJ perform these functions. The source code and documentation for both of these subroutines are contained in Appendix A. Note: If applying IJTOLL and LLTOIJ to the Mapped GAC Product, use a prime longitude of +80W.

5.3.1.1 Mapped GAC (Polar Stereographic) Product - Oct. 26, 1994 to present

On Oct. 26, 1994, NESDIS replaced the Polar Stereographic GAC mapping system with the NOAA-KLM master map system. This resulted in corresponding format changes. This section describes the format of the Polar Stereographic Mapped GAC product in use since Oct. 26, 1994.

The data are organized as daytime and nighttime for the northern and southern hemispheres. The daytime data contain both visible (Channel 1) and IR (Channel 4) data while the nighttime data contain only the IR data. The data are reported in pairs of files. The first file of each file pair consists of a documentation record for that variable, immediately followed by an EOF and a second file containing the data records for the same variable. All records are 16,384 bytes in length. Both documentation and data records are in binary format and have the same length. A value of zero indicates missing data.

Every day a 3480 cartridge is created which contains one day of data in the Polar Stereographic projection. Table 5.3.1.1-1 contains the general file structure of the daily KLM Master map cartridge. Each cartridge contains 12 files arranged as shown in the table.

Table 5.3.1.1-1. General Structure of the Polar Stereographic KLM Master Map cartridge.

File #	Record #	Contents
Daytime Northern Hemisphere - Visible Channels		
1	1	Channel 1 documentation record. See Table 5.3.1.1-2 for format.
2	1-1024	Channel 1 data records. Consists of 16,384 bytes of data or 4 mapped rows of data. Each row contains 4096 pixels of data. Each pixel is one byte. A value of 0 indicates missing data.
Daytime Northern Hemisphere - IR Channels		
3	1	Channel 4 documentation record. See Table 5.3.1.1-2 for format.
4	1-1024	Channel 4 data records. Same as File 2 data records.
Daytime Southern Hemisphere - Visible Channels		
5	1	Channel 1 documentation record. See Table 5.3.1.1-2 for format.
6	1-1024	Channel 1 data records. Same as File 2 data records.
Daytime Southern Hemisphere - IR Channels		
7	1	Channel 4 documentation record. See Table 5.3.1.1-2 for format.
8	1-1024	Channel 4 data records. Same as File 2 data records.
Nighttime Northern Hemisphere - IR Channels		
9	1	Channel 4 documentation record. See Table 5.3.1.1-2 for format.
10	1-1024	Channel 4 data records. Same as File 2 data records.
Nighttime Southern Hemisphere - IR Channels		
11	1	Channel 4 documentation record. See Table 5.3.1.1-2 for format.
12	1-1024	Channel 4 data records. Same as File 2 data records.

The variables reported in the documentation record are all INTEGER*2 with the exception of the satellite type in the first two bytes of the record, which is CHARACTER*2. Table 5.3.1.1-2 defines the basic documentation record format.

Table 5.3.1.1-2. Format of Documentation Record for Polar Stereographic KLM Master Map Data.	
Byte #	**Contents**
1-2	Satellite type, e.g., NH=NOAA-H (CHARACTER*2)
3-4	Satellite ID: 0=morning satellite 1=afternoon satellite
5-6	Data set type: 1=LAC 2=GAC 3=HRPT
7-8	Projection type: 0=unmapped 1=Mercator 2=Polar 3=linear latitude/longitude
Image boundaries	
9-10	Beginning latitude x 128; North>0; South<0
11-12	Ending latitude x 128
13-14	Beginning longitude x 128; East>0; West<0
15-16	Ending longitude x 128
17-18	Mapped resolution x 100; km for polar and Mercator projections; degree/pixel for linear latitude/longitude projections; sampling interval for unmapped projection
19-22	Spares
Polar Projection Data	
23-24	Polar grid mesh size (grid size that corresponds to resolution, e.g., 64=1/64 grid)
25-26	Number of grid points (that correspond to grid size, e.g., 1/64 corresponds to 4096 points)

27-28	Hemisphere: 1=Northern -1=Southern
29-30	Prime longitude; East>0; West<0
Grid Offsets	
31-32	IOFF; grid coordinates of top left corner of the image (not applicable for unmapped projections)
33-34	JOFF
Image Size	
35-36	Number of rows
37-38	Number of columns
39-42	Spares
43-44	Composite flag: 0=no composite 1=composite based on minimum nadir angle 2=retain average value 3=retain later value 4=retain warmer value 5=retain colder value
45-46	Calibration flag: 0=raw counts 1=radiances 2=calibrated to albedos and brightness temperatures 3=calibrated to albedos and GOES counts
47-48	Fill-up options: 0=no fill up 1=fill up using averages 2=fill up using adjacent pixel values
49-50	Channel number: 1-5=channel number 101=scan angle 102=satellite zenith angle 103=solar zenith angle 104=relative azimuth angle 105=scan time 201=SST split window 202=SST dual window 203=SST Triple window

51-52	Data ID: 0=visible 1=infrared 2=ancillary
Data Correction Flags	
53-54	Sun normalization: 0=not performed 1=performed
55-56	Limb correction: 0=not performed 1=performed
57-58	Nonlinearity correction: 0=not performed 1=performed
59-60	Number of orbits processed
Channel Images	
61-62	Number of channels produced
63-64	Pixel size: 1=1 byte 2=2 bytes
65-66	Starting block number
67-68	Ending block number
Ancillary Data	
69-70	Number of ancillary parameters produced
71-72	Pixel size: 1=1 byte 2=2 bytes
73-74	Starting block number
75-76	Ending block number
77-78	Block size of image files
79-80	Compression flag
81-100	Spares
Orbit 1 information	

101-102	Orbital node over region: -1=ascending 1=descending 2=both
103-104	Day/night flag: 0=day 1=night
Image Data Boundaries	
105-106	Start row
107-108	Start column
109-110	End row
111-112	End column
Orbit Start Time	
113-114	Year of century
115-116	Day of year
117-118	Month and day of month (month x 100) + day
119-120	Hours and minutes (hours x 100) + minutes
121-122	Seconds
123-124	Milliseconds
Orbit End Time	
125-126	Year of century
127-128	Day of year
129-130	Month and day of month (month x 100) + day
131-132	Hours and minutes (hours x 100) + minutes
133-134	Seconds
135-136	Milliseconds
137-138	Processing Block ID (orbit number)
Quality Flags	
139-140	Ramp/auto calibration flag
141-142	Number of data gaps

143-144	Sync errors
145-146	TIP parity errors
147-148	Auxiliary errors
149-150	Calibration parameter ID
151-152	DACS status
Calibration Coefficients	
153-154	Channel 1 slope x 10,000
155-156	Channel 1 intercept x 1,000
157-158	Channel 2 slope x 10,000
159-160	Channel 2 intercept x 1,000
161-166	Spares
Orbit 2 Information	
167-232	Same as bytes 102-166
Orbit 3 Information	
233-298	Same as bytes 102-166
...	...
Orbit n Information	
((n-1) x 66+102)-((n-1) x 66+166)	Same as bytes 102-166

Each data record (16,384 bytes) consists of four mapped rows, each containing 4096 pixels of data. Each pixel is represented by one byte of data.

5.3.2 **Mapped GAC (Mercator)**

Beginning June 24, 1985, SSB began archiving the Mapped GAC Product in the Mercator form. These mapped mosaics are displayed on a Mercator map which extends from 40N to 40S with a 9.8 km resolution at the Equator, and 7.5 km resolution at 40N and 40S. The Mercator mapped GAC data reside in Files 9 through 11 of the same archive tape as the Polar Stereographic mapped GAC. The Mercator files have the file structure as shown in Table 5.3.2-1. The first record of each file contains documentation for that file and it has the same format as the documentation for the Polar Stereographic mapped GAC product described in Section 5.3.1.

Table 5.3.2-1. File Structure of Mapped GAC Data (Mercator			
File #	**Record #**	**Bytes/record**	**Contents**
9	1	4052	Nighttime IR documentation
	2-985	4052	Nighttime IR data
10	1	4052	Daytime IR documentation
	2-985	4052	Daytime IR data
11	1	4052	Visible documentation
	2-985	4052	Visible data

The data are contained in records 2 through 985 of each Mercator file. Each record contains data for one mapped row and 984 records comprise the Mercator map. The 4,052 byte records hold 4,050 8-bit bytes of data with the rightmost two bytes zero filled. The temperature values for IR data range from 0 (warm) to 254 (cold) and the visible data count values range from 0 (dark) to 254 (bright). Figure 5.3.2-1 shows the arrangement of the Mercator mapped GAC data for one file.

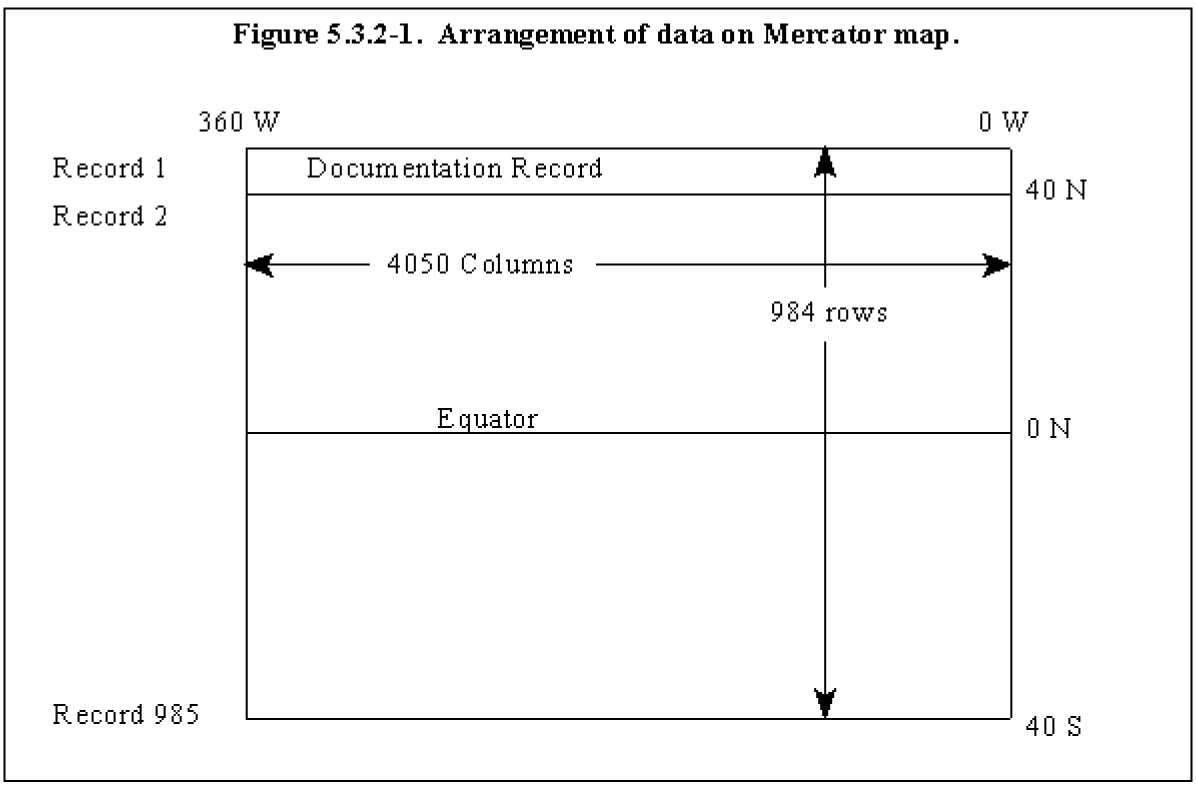

Figure 5.3.2-1. Arrangement of Data on Mercator Map.

5.3.2.1 Mapped GAC (Mercator) Product - Oct. 26, 1994 to present

On Oct. 26, 1994, NESDIS replaced the Polar Stereographic GAC mapping system with the NOAA-KLM master map system. This resulted in corresponding format changes. This section describes the format of the Mercator Mapped GAC product in use since Oct. 26, 1994.

The data reported are organized as visible (Channel 1), and daytime and nighttime IR (Channel 4). These data are reported in pairs of files, totaling six files. The first file of each file pair consists of a documentation record for that variable, immediately followed by an EOF and a second file containing the data records for the same variable. All records are 4,052 bytes in length. Both documentation and data records are in binary format and have the same length. A value of zero indicates missing data.

Every day a 3480 cartridge is created which contains a day of data in the Mercator projection. Table 5.3.2.1-1 contains the general file structure of the daily Mercator Master map cartridge. Each cartridge contains 6 files arranged as shown in the table.

Table 5.3.2.1-1. General Structure of the Mercator KLM Master Map Cartridge.

File #	Record #	Contents
Visible Channels		
1	1	Channel 1 documentation record. See Table 5.3.1.1-2 for format
2	1-984	Channel 1 data records. Consists of 4,052 bytes of data or 1 mapped row of data. Each row contains 4052 pixels of data. Each pixel is one byte. A value of 0 indicates missing data.
IR Channels (Daytime)		
3	1	Channel 4 documentation record. See Table 5.3.1.1-2 for format.
4	1-984	Channel 4 data records. Same as File 2 data records
IR Channels (Nighttime)		
5	1	Channel 4 documentation record. See Table 5.3.1.1-2 for format.
6	1-984	Channel 4 data records. Same as File 2 data records

The format of the basic documentation record is the same as the Polar Stereographic KLM Master Map which is contained in Table 5.3.1.1-2.

Each data record (4,052 bytes) consists of one mapped row, containing 4052 pixels of data. Each pixel is represented by one byte of data.

5.4 Radiation Budget Products

There are six types of digital Radiation Budget products that were archived by SSB for the NOAA Polar Orbiting satellites through May 1999. For any data after May 1999, including some NOAA-14 data, please see Section 9.3.1 of the NOAA KLM User's Guide for the archive format. All radiation budget products are currently produced by the NOAA/NESDIS Office of Satellite Data Processing and Distribution's Product Systems Branch (OSDPD/PSB).

The first type is the Monthly Radiation Budget. This data has eleven fields per day and one calendar month per IBM 3480 cartridge. Archival of these tapes began in January 1979 and continues through the present. See Section 5.4.1 for a full description and format of this product.

The second type of Radiation Budget product is known as the Seasonal Radiation Budget. There are twenty fields per day and three calendar months per IBM 3480 cartridge, stacked by season (i.e., Winter - December through February, Spring - March through May, Summer - June through August, and Autumn - September through November). These twenty fields include everything that is contained on the Monthly Radiation Budget tapes plus more. Archival began with the June through August 1974 season and continues through the present. See Section 5.4.2 for a description and format of this product.

The third type of Radiation Budget product is the 10-year Mercator Radiation Budget product which is a subset of the Seasonal Radiation Budget. There are four fields per day mapped into a Mercator array and three IBM 3480 cartridges contain 10 years of **non-contiguous** data. The 10-year period includes from June 1974 through March 1978 (which uses the VHRR instrument from NOAA-3, 4, and 5), and January 1979 through February 1986 (using the AVHRR instrument on the TIROS-N series).

The fourth type of Radiation Budget product is the Monthly Mean Radiation Budget. There are forty-five months (June 1974 through February 1978) of mean radiation budget data (which were generated from the VHRR instrument on-board NOAA-3, -4, and -5) which are contained on two IBM 3480 cartridges. One CCT contains data on Mercator grids and the other CCT contains the same data on Polar Stereographic grids. The algorithm used to compute radiation budget parameters was changed after the generation of these tapes and these are the only RA/ASB Radiation Budget products which have not been corrected. The monthly mean data for the TIROS-N series are available from January 1979 through the present. See Section 5.4.3 for a description and format of this product

The fifth and sixth types of radiation budget products are the seasonal mean and the annual mean. The seasonal mean consists of averages over each season while the annual mean consists of averages calculated over each calendar year. Both types of data have the same format as the monthly mean radiation budget product described in Section 5.4.3.

5.4.1 Monthly Radiation Budget

The format of the monthly radiation budget data has evolved over the years since it was first offered in January 1979 with the onset of TIROS-N polar orbiter data. The data between January 1979 and the end of September 1988 were created with a certain format and blocking scheme (herein referred to as the "Old" format). These data are described in Section 5.4.1.1. Beginning in July 1987, a new format accompanied by a new blocking scheme was introduced (herein referred to as the "New" format). These data are described in Section 5.4.1.2. However, there was a certain time period in which both formats were mixed on the archive tapes (July 1987 - September 1988) depending on whether the satellite was designated primary or secondary. The following documentation attempts to record the logical progression of the monthly radiation budget data formats.

5.4.1.1 **Old Monthly Radiation Budget format**

The monthly radiation budget archive tape contains daily sets of radiation budget data fields for a calendar month. A daily set consists of both Polar Stereographic and 2.5 x 2.5 degree gridded Mercator arrays of Nighttime Longwave Radiation, Daytime Longwave radiation, and Absorbed Solar Radiation. Polar Stereographic arrays of Available Solar Energy are also included.

Each daily set of data fields contains the following arrays stacked in the file in this order:

1) Nighttime Longwave Radiation Northern Hemisphere Polar stereo (125 x 125)
2) Nighttime Longwave Radiation Southern Hemisphere Polar stereo (125 x 125)
3) Nighttime Longwave Radiation 2.5 x 2.5 degree (144 x 72)
4) Daytime Longwave radiation Northern Hemisphere Polar stereo (125 x 125)
5) Daytime Longwave radiation Southern Hemisphere Polar stereo (125 x 125)
6) Daytime Longwave radiation 2.5 x 2.5 degree (144 x 72)
7) Available Solar Energy Northern Hemisphere Polar stereo (125 x 125)
8) Available Solar Energy Southern Hemisphere Polar stereo (125 x 125)
9) Absorbed Solar Radiation Northern Hemisphere Polar stereo (125 x 125)
10) Absorbed Solar Radiation Southern Hemisphere Polar stereo (125 x 125)
11) Absorbed Solar Radiation 2.5 x 2.5 degree (144 x 72)

These daily sets of data fields are stacked chronologically on the tape, day by day (up to 31 days worth of data). All data values are contained in 2-byte integer words and are in units of W/m^2 x 10. Missing data values are indicated by a value of -9999. The data values of Available Solar Energy are flagged with a minus sign at those grid points where the corresponding values of Absorbed Solar Energy are missing.

Each monthly radiation budget tape contains two files. The first file contains the data for the primary operational satellite and the second file contains data for the secondary operational satellite. The block size is 4000 bytes with record format VS (variable length records spanning block boundaries) and all records are 4000 bytes in length except for the records containing the remaining data in each array. Since the tape is written with the IBM VS option, the first 8 bytes of each 4000-byte physical record contain VS information and should be skipped by the non-IBM user. Table 5.4.1.1-1 shows the expected record lengths (which includes the 8-bytes of VS information) for the first three data arrays.

Table 5.4.1.1-1. Record Length for First Three Data Arrays in the Old Monthly Heat Budget Data.

Record #	# of Bytes	Type of data array
1	4000	Nighttime Longwave Radiation Polar Stereo Northern Hemisphere (125 x 125)
2	4000	
3	4000	
4	4000	
5	4000	
6	4000	
7	4000	
8	3314	
9	4000	Nighttime Longwave Radiation Polar Stereo Southern Hemisphere (125 x 125)
10	4000	
11	4000	
12	4000	
13	4000	
14	4000	
15	4000	
16	3314	
17	4000	Nighttime Longwave Radiation Mercator (144 x 72)
18	4000	
19	4000	
20	4000	
21	4000	
22	784	

In the Polar Stereographic form, each hemisphere of data is contained in a 125 x 125 array written row by row. These data are contained in 31,250-byte logical records. The data values fit the intersections of a square mesh overlaid on a Polar Stereographic projection. Array (63,63) lies on the Pole. The arrays for both hemispheres are oriented such that Array (63,1) represents the data at 0.4N, 100E in the Northern Hemisphere array and 0.4S, 80W in the Southern Hemisphere array.

Documentation for the Polar Stereographic arrays is contained in Table 5.4.1.1-2.

Table 5.4.1.1-2. Documentation for the Polar Stereographic Arrays.	
Location	**Contents**
Array (1,1)	Month
Array (2,1)	Day
Array (3,1)	Year
Array (4,1)	Data type: 1=day flux 2=night flux 4=Available Solar Energy 5=Absorbed Solar Radiation
Array (5,1)	Hemisphere: 1=Northern 2=Southern

The 2.5 x 2.5 degree gridded Mercator arrays contain data values that fit the intersection of a 2.5 degree latitude/longitude mesh that covers the globe. These arrays are contained in 20,736-byte logical records. The top row of 144 words contains documentation and the data values for the Poles. In the Absorbed Solar Radiation array, Array (27,1) through Array (99,1) contain values of Available Solar Energy for each 2.5 degree interval of latitude from 90N to 90S. The remaining 71 rows of 144 words each contain data for the latitude circles at 2.5 degree intervals from 87.5N to 87.5S. The 144 data values in each row fit a latitude circle in which the first word contains the data value for 0E, the second word 2.5E, etc. Missing data have been filled in by interpolation and these values are flagged with a minus sign.

Documentation for the 2.5 x 2.5 degree Mercator arrays is contained in Table 5.4.1.1-3.

Table 5.4.1.1-3. Documentation for the 2.5 x 2.5 Degree Mercator Arrays	
Location	**Contents**
Array (3,1)	Year
Array (4,1)	Month
Array (5,1)	Day
Array (6,1)	Data type: 1=day flux 2=night flux 4=Available Solar Energy 5=Absorbed Solar Radiation

Array (25,1)	North Pole data value
Array (26,1)	South Pole data value

5.4.1.2 **New Monthly Radiation Budget Format**

The monthly radiation budget (also known as the Radiation Budget monthly) data contains daily sets of Radiation Budget data fields for a calendar month. The data fields are copied from the Radiation Budget 37-day file in chronological order.

Each daily set of data contains Polar Stereographic hemispheric arrays and 2.5 x 2.5 degree global Mercator arrays. The arrays contain data parameters which describe the three Radiation Budget quantities: Daytime Longwave Radiation, Nighttime Longwave Radiation, and Absorbed Solar Radiation. There are also Polar Stereographic hemispheric arrays of Available Solar Energy.

In addition to the arrays containing average values of the Radiation Budget quantities, there are arrays of Class Interval Populations and arrays of the variances of the values making up the averages.

A daily set of fields is made up of three subsets of arrays. Each subset contains data parameters which describe one of the Radiation Budget quantities. A daily set contains the following subsets:

1. Nighttime Longwave Radiation
2. Daytime Longwave Radiation
3. Absorbed Solar Radiation

Each subset contains the following arrays:

1. Northern Hemisphere polar stereo array of data values (125 x 125)
2. Southern Hemisphere polar stereo array of data values (125 x 125)
3. 2.5 x 2.5 degree Mercator array of data values (144 x 72)
4. Northern Hemisphere polar stereo array of 1st Class Interval Pop. (125 x 125)
5. Southern Hemisphere polar stereo array of 1st Class Interval Pop. (125 x 125)
6. Northern Hemisphere polar stereo array of 2nd Class Interval Pop. (125 x 125)
7. Southern Hemisphere polar stereo array of 2nd Class Interval Pop. (125 x 125)
8. Northern Hemisphere polar stereo array of 3rd Class Interval Pop. (125 x 125)
9. Southern Hemisphere polar stereo array of 3rd Class Interval Pop. (125 x 125)
10. Northern Hemisphere polar stereo array of variances (125 x 125)
11. Southern Hemisphere polar stereo array of variances (125 x 125)
12. 2.5 x 2.5 degree Mercator array of variances (144 x 72)

The subset containing Absorbed Solar Radiation data differs from the others in that there are the following arrays at the beginning of the subset:

1. Northern Hemisphere polar stereo array of Available Solar Energy (125 x 125)
2. Southern Hemisphere polar stereo array of Available Solar Energy (125 x 125)

In the Polar Stereographic form, each hemisphere of data is contained in a 125 x 125 array written row by row. The data values fit the intersections of a square mesh overlaid on a Polar Stereographic projection. Array (63,63) lies on the Pole. The arrays for both hemispheres are oriented such that Array (63,1) represents the data at 0.4N, 100E in the Northern hemisphere array and 0.4S, 80W in the Southern hemisphere array.

Documentation for the Polar Stereographic arrays is contained in Table 5.4.1.2-1.

Table 5.4.1.2-1. Documentation for the Monthly Polar Stereographic Arrays.

Location	Description
Array (1,1)	Month
Array (2,1)	Day
Array (3,1)	Year
Array (4,1)	Data Type: 1st digit (or only digit) 1 = Daytime Longwave Radiation 2 = Nighttime Longwave Radiation 4 = Available Solar Energy 5 = Absorbed Solar Radiation 2nd digit 6 = Class Interval Population 7 = Variance 3rd digit 1 = 1st Class Interval 2 = 2nd Class Interval 3 = 3rd Class Interval

The 2.5 x 2.5 degree arrays contain data values that fit the intersections of a 2.5 degree latitude/longitude mesh that covers the globe. The top row of 144 contains documentation and the values for the Poles. The remaining 71 rows, of 144 words each, contain data for the latitude circles at 2.5 degree intervals from 87.5N to 87.5S. The 144 data values in each row fit a latitude circle where the first word contains the value for 0E longitude, the second word contains the value for 2.5E longitude, etc. In all the 2.5 x 2.5 degree arrays, missing data has been filled in by interpolation and all interpolated values are flagged with a minus sign.

The format for the documentation of the 2.5 by 2.5 degree arrays is contained in Table 5.4.1.2-2.

Table 5.4.1.2-2. Documentation in the Monthly 2.5 x 2.5 Degree Mercator Arrays.

Location	Description
Array (3,1)	Year
Array (4,1)	Month
Array (5,1)	Day
Array (6,1)	Data type: 1 = Daytime Longwave Radiation 2 = Nighttime Longwave Radiation 3 = Absorbed Solar Radiation
Array (25,1)	North Pole value
Array (26,1)	South Pole value

The 2.5 x 2.5 degree array of Absorbed Solar Radiation contains values of Available Solar Energy in the top row. Beginning in Array (27,1) through Array (99,1) are the values of Available Solar Energy for each 2.5 degrees of latitude from 90N to 90S.

All data values and variances are in units of W/m^2. All data values have been multiplied by 10. In all fields, missing data are indicated by -9999. All fields reside in INTEGER*2 (FORTRAN 77) arrays.

The data values in the Polar Stereographic arrays of Available Solar Energy are flagged with a minus sign at those grid points where the corresponding values of Absorbed Solar Radiation are missing.

In the Class Interval Population arrays of Outgoing Longwave radiation, the populations represent the following:

1st Class Interval = Values greater than 174
2nd Class Interval = Values from 136 through 174
3rd Class Interval = Values less than 136

In the Class Interval Population arrays of Absorbed Solar Radiation, the populations represent the following:

1st Class Interval = Values greater than 150
2nd Class Interval = Values from 100 through 150
3rd Class Interval = Values less than 100

The Class Interval Populations are biased with a value of -9000. Missing data is indicated with a value of -9999. A value of 9000 must be added to all values greater than -9999 in order to obtain the true population.

Each 125 x 125 Polar Stereographic array is written to tape in six segments. The first five segments contain 21 rows (5,250 bytes), and the sixth segment contains 20 rows (5,000 bytes).

Each 144 x 72 Mercator array is written to tape in four segments of 18 rows each (5,184 bytes).

Table 5.4.1.2-3 shows how the data in the New format are blocked on the tape.

Table 5.4.1.2-3. Blocking of Data for the Monthly Radiation Budget	
Record #	**# of Bytes**
Nighttime Longwave radiation Polar Stereo Northern Hemisphere (125 x 125)	
1	4000
2	1266
3	4000
4	1266
5	4000
6	1266
7	4000
8	1266
9	4000
10	1266
11	4000
12	1016
Nighttime Longwave Radiation Polar Stereo Southern Hemisphere (125 x 125)	
13	4000
14	1266
15	4000
16	1266
17	4000
18	1266
19	4000
20	1266

21	4000
22	1266
23	4000
24	1016
Nighttime Longwave Radiation Mercator (144 x 72)	
25	4000
26	1200
27	4000
28	1200
29	4000
30	1200
31	4000
32	1200

Radiation budget data collected between July 1987 and July 1988, had two files which were not only blocked **differently,** but were also formatted differently. File 1 contained radiation budget data for the primary satellite (NOAA-9) in the old format and was blocked as shown in Table 5.4.1.1-1, while File 2 which contained radiation budget data for the secondary satellite (NOAA-10) in the new format was blocked as shown in Table 5.4.1.2-3. This confusing situation finally ended when NOAA-9 was replaced by NOAA-11 as the primary satellite in October 1988. At that time, the new format was used for both operational satellites.

From October 1988 through May 1999, monthly radiation budget data have had both files blocked as shown in Table 5.4.1.2-3.

5.4.2 Seasonal Radiation Budget Product

The Seasonal Radiation Budget archive tape contains 90 - 92 daily data sets. A daily data set consists of four radiation fields written in the following order: 1) Daytime Outgoing Longwave, 2) Absorbed Solar Energy, 3) Available Solar Energy, and 4) Nighttime Outgoing Longwave. Each radiation field consists of five arrays in the following order: 1) Northern Hemisphere Polar Stereographic, 2) Southern Hemisphere Polar Stereographic, 3) Northern Hemisphere Polar Chip, 4) Southern Hemisphere Polar Chip, and 5) a latitude/longitude Mercator grid. These data are available from June 1974 through May 1999.

Each daily data set contains the following arrays in the indicated order:

1. Day Flux Northern Hemisphere 125 x 125 array

2. Day Flux Southern Hemisphere 125 x 125 array
3. Day Flux Northern Hemisphere Chip 45 x 45 array
4. Day Flux Southern Hemisphere Chip 45 x 45 array
5. Day Flux Mercator 144 x 72 array
6. Absorbed Solar Energy Northern Hemisphere 125 x 125 array
7. Absorbed Solar Energy Southern Hemisphere 125 x 125 array
8. Absorbed Solar Energy Northern Hemisphere Chip 45 x 45 array
9. Absorbed Solar Energy Southern Hemisphere Chip 45 x 45 array
10. Absorbed Solar Energy Mercator 144 x 72 array
11. Available Solar Energy Northern Hemisphere 125 x 125 array
12. Available Solar Energy Southern Hemisphere 125 x 125 array
13. Available Solar Energy Northern Hemisphere Chip 45 x 45 array
14. Available Solar Energy Southern Hemisphere Chip 45 x 45 array
15. Available Solar Energy Mercator 144 x 72 array
16. Nighttime Flux Northern Hemisphere 125 x 125 array
17. Nighttime Flux Southern Hemisphere 125 x 125 array
18. Nighttime Flux Northern Hemisphere Chip 45 x 45 array
19. Nighttime Flux Southern Hemisphere Chip 45 x 45 array
20. Nighttime Flux Mercator 144 x 72 array

In the Polar Stereographic form, each hemisphere of data is contained in a 125 x 125 array written row by row. The data values fit the intersections of a square mesh overlaid on a Polar Stereographic projection. Array (63,63) lies on the Pole. The arrays for both hemispheres are oriented such that array (63,1) is at latitude 0.4N and longitude 100E in the Northern Hemisphere array and at latitude 0.4S and longitude 80W in the Southern Hemisphere array.

The documentation in the Polar Stereographic arrays is contained in Table 5.4.2-1.

Table 5.4.2-1. Documentation in the Seasonal Polar Stereographic arrays.

Location	Description
Array (1,1)	Month
Array (2,1)	Day
Array (3,1)	Year
Array (4,1)	Data type: 1 = Day Flux 2 = Night Flux 4 = Available Solar Energy 5 = Absorbed Solar Energy
Array (5,1)	Hemisphere: 1 = Northern 2 = Southern

The Polar Stereographic chips are the center portion of the complete 125 x 125 Polar Stereographic arrays. The 45 x 45 chip arrays are written row by row and oriented in the same manner as the larger Polar Stereographic arrays. The chips contain no documentation. Missing data have been filled in by interpolation and all interpolated values are flagged with a minus sign.

The Mercator arrays contain data values that fit the intersections of a 2.5 degree latitude/longitude mesh that covers the globe. The top row of 144 words (1 word = 2 bytes) contains documentation. The remaining 71 rows of 144 words each contain data for the latitude circles at 2.5 degree intervals from 87.5N to 87.5S. The 144 word data values in each row fit a latitude circle where the first word contains the data value for 0E, the second word 2.5E, etc. Missing data are handled in the same manner as described in the Polar Stereographic chips.

The documentation in the 144 x 72 Mercator arrays is contained in Table 5.4.2-2.

Table 5.4.2-2. Documentation in the Seasonal 144 x 72 Mercator Arrays.

Location	Description
Array (3,1)	Year
Array (4,1)	Month
Array (5,1)	Day
Array (6,1)	Data type
Array (7,1) - (10,1)	Satellite name in BCD
Array (25,1)	North Pole data value
Array (26,1)	South Pole data value

All data are stored in 2 byte (16 bit) words and recorded in binary. All data values are in units of W/m^2 and have been multiplied by 10 before they are stored. The data values of Available Solar Energy are flagged with a minus sign at those grid points where the corresponding values of Absorbed Solar Energy are missing or have been interpolated. Missing data is indicated by a value of -9999_{10}. Note: the record format VS option was used to create the CCT (See Section 5.4.1 for further explanation).

5.4.2.1 10-Year Mercator Radiation Budget Product

The 10-Year Mercator Radiation Budget product consists of daily data sets in Mercator form spanning approximately ten-years (non-contiguous). This product is a subset of the Seasonal Radiation Budget product. The daily data contain the following arrays in the indicated order:

1. Day flux Mercator 144 x 72 array

2. Absorbed Solar Energy Mercator 144 x 72 array
3. Available Solar Energy Mercator 144 x 72 array
4. Nighttime Flux Mercator 144 x 72 array

The Mercator arrays and data values are structured exactly the same as the Mercator arrays described in Section 5.4.2. However, the documentation in the 144 x 72 Mercator arrays differs slightly and has the format shown in Table 5.4.2.1-1.

Table 5.4.2.1-1. Format of documentation for the 144 x 72 Mercator Arrays.

Location	Content
Array (3,1)	Year
Array (4,1)	Month
Array (5,1)	Day
Array (6,1)	Data Type: 1=Day Flux 2=Night Flux 4=Available Solar Energy 5=Absorbed Solar Energy
Array (25,1)	North Pole data value
Array (26,1)	South Pole data value

Three IBM 3480 cartridges contain the data as follows:

1. June 1, 1974 - March 16, 1978 (Pre TIROS-N satellites, NOAA-3, 4, 5)
2. January 1, 1979 - November 30, 1982 (TIROS-N series)
3. December 1, 1982 - February 28, 1986 (TIROS-N series)

These non-labeled archive tapes were created using the record format VS option and a block size of 4000.

5.4.3 Monthly Mean Radiation Budget Products

Two formats exist for the Monthly Mean Radiation Budget Products. Basically, the only difference is that the older format separated the two projections (Mercator and Polar Stereographic) onto two different archive tapes, while the current format combines both projections on the same archive tape. The current format began on Oct. 1, 1987 and continued through May 1999. This format is described in Section 5.4.3.1. The one used for the period ending on Sept. 30, 1987, is described in Section 5.4.3.2.

5.4.3.1 Monthly Mean Radiation Budget Products (Oct. 1, 1987 to present)

The Monthly Mean Radiation Budget archives contain Monthly Mean data in 2.5 x 2.5 degree latitude/longitude grid called a Mercator Array and a 45 x 45 grid on a Polar Stereographic map base. The mean data are derived from the daily archived arrays for each calendar month. The Monthly Mean data set begins with November 1988. A Monthly Mean data set consists of four groups of three (12 total) Radiation Fields. The groups are written in the following order: Daytime Outgoing Longwave Radiation, Nighttime Outgoing Longwave Radiation, Absorbed Solar Energy and Available Solar Energy. Each group of three fields consist of a Northern Hemisphere polar stereo (45 x 45) chip, a Southern Hemisphere chip, and a 144 x 72 Mercator field.

Thus, the twelve Radiation Fields are stored in the following order:

1. Daytime Flux Northern Hemisphere 45 x 45 Array
2. Daytime Flux Southern Hemisphere 45 x 45 Array
3. Daytime Flux Mercator 144 x 72 Array
4. Nighttime Flux Northern Hemisphere 45 x 45 Array
5. Nighttime Flux Southern Hemisphere 45 x 45 Array
6. Nighttime Flux Mercator 144 x 72 Array
7. Absorbed Solar Energy Northern Hemisphere 45 x 45 Array
8. Absorbed Solar Energy Southern Hemisphere 45 x 45 Array
9. Absorbed Solar Energy Mercator 144 x 72
10. Available Solar Energy Northern Hemisphere 45 x 45 Array
11. Available Solar Energy Southern Hemisphere 45 x 45 Array
12. Available Solar Energy Mercator 144 x 72 Array

The 45 x 45 Polar Stereographic Array covers the area of 50N to 90N and 50S to 90S. The 45 x 45 Arrays are written row by row. The data values fit the intersections of a square mesh overlaid on a Polar Stereographic projection. Array (23,23) lies on the Pole. The arrays for both hemispheres are oriented such that Array (23,1) is at latitude 50.4N and longitude 80W in the Northern Hemisphere Array and at latitude 50.4S and longitude 80W in the Southern Hemisphere Array. The chips contain no documentation. Missing data have been filled in by interpolation and all interpolated values are flagged with a minus sign.

The Mercator Arrays contain data values that fit the intersections of a 2.5 degree latitude/longitude mesh that covers the globe. The top row of 144 words (1 word = 2 bytes) contains documentation. The remaining 71 rows of 144 words each contain data for the latitude circles at 2.5 degree intervals from 87.5N to 87.5S. The 144 word data values in each row fit a latitude circle where the first word contains the data value for 0E, the second word 2.5E, etc. Missing data are handled in the same manner as described for the Polar Stereographic Arrays.

The documentation in the 144 x 72 Mercator Arrays is contained in Table 5.4.3.1-1.

Table 5.4.3.1-1. Format of Documentation for the 144 x 72 Mercator Arrays.

Location	Content

Array (3,1)	Year
Array (4,1)	Month
Array (5,1)	Day
Array (6,1)	Data Type: 1=Day Flux 2=Night Flux 4=Available Solar Energy 5=Absorbed Solar Energy
Array (7,1)	Number of days averaged
Array (25,1)	North Pole data value
Array (26,1)	South Pole data value

All data are stored in IBM 4 byte (REAL*4) words and recorded in binary on IBM 3480 cartridges. All data values are in units of W/m^2. The data values of Available Solar Energy are flagged with a minus sign at those grid points where the corresponding values of Absorbed Solar Energy are missing or have been interpolated.

5.4.3.2 **Monthly Mean Radiation Budget Products (before Oct. 1,1987**

The Monthly Mean Radiation Budget archive tapes consist of two CCTs, one CCT contains the monthly mean data in 2.5 x 2.5 degree Mercator form and the other contains the data in Polar Stereographic form. Section 5.4.3.1 describes the format of the Mercator form and Section 5.4.3.2 contains the format of the Polar Stereographic form.

5.4.3.2.1 **Monthly Mean Radiation Budget (2.5 x 2.5 degree Mercator Arrays before Oct. 1, 1987)**

The Monthly Mean Radiation Budget product in Mercator form contains 45 sets of monthly mean Radiation Budget data. The mean data are derived from the daily archived arrays for the calendar months. Each set consists of four arrays in the following order: 1) Day IR Flux, 2) Night IR Flux, 3) Absorbed Solar Energy, and 4) Available Solar Energy. Each array contains 144 X 72 words. The data are stored in one file consisting of 180 records (4 arrays x 45 sets). The documentation and data values for the Poles for each array are contained in the first row of 144 words as shown in Table 5.4.3.2.1-1.

Table 5.4.3.2.1-1. Documentation and Data Values for the Poles for Each Array.

Location	Contents
Array (1,1)	Null
Array (2,1)	Null

Array (3,1)	Year of beginning date
Array (4,1)	Month of beginning date
Array (5,1)	Day of beginning date
Array (6,1)	Data type: 1=Day IR Flux 2=Night IR Flux; 4=Available Solar Energy 5=Absorbed Solar Energy
Array (7,1)	Number of days used to compute mean
Array (8,1)	Month of ending date
Array (9,1)	Day of ending date
Array (10,1)	Year of ending date
Array (25,1)	North Pole data value
Array (26,1)	South Pole data value

The first set of data contains June 1974 and the 45th set contains February 1978 data with all data sets in between ordered chronologically. The data value for each location has been derived by a four-point smoothing routine from the 125 x 125 hemispheric arrays (See Section 5.4.1) to represent the center of a 2.5 x 2.5 degree grid square. All data are recorded as 32-bit floating point words and are in units of W/m^2. Again, the record format VS option was used to create this CCT (See Section 5.4.1 for further explanation).

5.4.3.2.2 Monthly Mean Radiation Budget (Polar Stereographic Arrays before Oct. 1, 1987)

The Monthly Mean Radiation Budget product in Polar Stereographic form contains 45 set of monthly mean Radiation Budget data. A set consists of two hemispheric arrays for each of four data types. Each hemispheric array contains 125 words per row for 125 rows. The sequence of arrays per set is:

1. Day Flux, Northern Hemisphere
2. Day Flux, Southern Hemisphere
3. Night Flux, Northern Hemisphere
4. Night Flux, Southern Hemisphere
5. Absorbed Solar Energy, Northern Hemisphere
6. Absorbed Solar Energy, Southern Hemisphere
7. Available Solar Energy, Northern Hemisphere
8. Available Solar Energy, Southern Hemisphere

The documentation is contained in the first five words (16 bits) of the first row in each 125 x 125 array. Table 5.4.3.2.2-1 describes the documentation.

The documentation is contained in the first five words (16 bits) of the first row in each 125 x 125 array. Table 5.4.3.2.2-1 describes the documentation.

Table 5.4.3.2.2-1. Documentation in Polar Stereographic Projection.

Location	Contents
Array (1,1)	Month
Array (2,1)	Number of days in the mean
Array (3,1)	Year, expressed in units and tens only
Array (4,1)	Data Type: 1=Day Flux 2=Night Flux 4=Available Solar Energy (ASE) 5=Absorbed Solar Energy
Array (5,1)	Hemisphere: 1= Northern 2=Southern

Each 125 x 125 array represents a square mesh overlaid on a Polar Stereographic projection of the relevant hemisphere. Array (63,63) lies on the pole of that hemisphere. Array (1,63) is located 0.4 degrees poleward of the equator and 170W, while Array (125,1) is 0.4 degrees poleward at longitude 10E. Array (63,1) is located at 0.4N, l00E for the Northern hemisphere array and at 0.4S, 80W for the Southern hemisphere array.

All data are 16-bit integer words and are in units of W/m^2. The data and documentation words are multiplied by 10 before storing. All the data are contained in one file. Note: The record format VS option was used to create this CCT (see Section 5.4.1 for further explanation).

5.5 **SBUV/2 Ozone Products**

There are three types of SBUV/2 ozone products. They are the 1b Capture product, the Historical Instruments file product and the Product Master File product. The format description for all three of these products are listed in the *Solar Backscattered Ultraviolet Radiometer Version 2 (SBUV/2) User's Guide*, which is available from SSB.

The 1b Capture product contains all SBUV/2 sensor data and support data necessary for the derivation of atmospheric ozone and solar flux.

The Historical Instrument File contains the data necessary to characterize the instrument performance and albedo correction over time.

The Product Master File contains the ozone information derived by the ozone algorithm, located in space and time, other meteorological information developed in support of the ozone computations, parameters indicating the validity of the individual ozone retrievals and the radiance information derived from the SBUV/2 measurements.

There are two main classes of SBUV/2 ozone products: operational and reprocessed. The Operational products are generated by the NOAA/NESDIS Office of Satellite Data Processing and Distribution's Product Systems Branch. The Reprocessed products are generated by the NOAA/NESDIS Office of Research and Application's Physics Branch. Operational data are kept in the archive until replaced by Reprocessed data. There are 14 to 15 orbits per day and one calendar month per cartridge tape.

The operational NOAA-9 data set begins with March 1985 and ends February 20, 1998. The operational NOAA-11 data set begins with January 1989 and ends April 1995. It was restarted on June 8, 1999 and continues to the present. The operational NOAA-14 data set begins with February 1995 and continues to the present.

The NOAA-9 SBUV/2 total ozone data have been reprocessed for the time period 1985-1997 with improved instrument characterization and calibration. The improved calibration includes time dependent changes to solar diffuser reflectivity, photomultiplier tube gain range ratios, and photomultiplier tube hysteresis correction. The newly reprocessed NOAA-9 total ozone data have been validated at 2% by comparing with ozone measurements made by ground-based Dobson stations. The NOAA-9 profile ozone data will soon be reprocessed with improved calibration at shorter wavelengths.

The NOAA-11 SBUV/2 ozone data have been reprocessed for the time period 1989-1994 with improved instrument characterization and calibration. The improved calibration includes time dependent changes to solar diffuser reflectivity and photomultiplier tube gain range ratios. The reprocessed NOAA-11 total ozone data have been validated at 1% by comparing with ozone measurements made by ground-based Dobson stations. Reprocessing of NOAA-11 profile ozone data to correct for instrument and algorithm errors are currently underway.

The NOAA-14 SBUV/2 ozone data have been reprocessed for the time period 1995-1998 with improved instrument characterization and calibration. The improved calibration includes time dependent changes to solar diffuser reflectivity and photomultiplier tube gain range ratios. The reprocessed NOAA-14 total ozone data have been validated at 2% by comparing with ozone measurements made by ground-based Dobson stations.