APPENDIX E: **Historical Record of Significant Events Affecting the SST, Radiation Budget, and Aerosol Products Produced from TIROS-N series AVHRR Data**

This appendix contains a record of events that affect the SST, Radiation Budget and aerosol products generated by NOAA and also the SST Observation file generated by the Navy. Accordingly, this appendix is divided into two subsections: E.1 contains the changes made to NOAA products and E.2 has the change record for the Navy=s SST Observation product.

E.1 CHANGES MADE TO NOAA PRODUCTS

October 13, 1978
Launch of the TIROS-N spacecraft, the prototype for the third generation of polar-orbiting operational environmental satellites. The TIROS-N series replaces the ITOS series (i.e., NOAA-1 to NOAA-5).

December 4, 1978
Begin calculation and archive of sea surface temperatures (SST's) derived from TIROS-N data. Equivalent black body temperatures are obtained from the 11 micrometer channel of the AVHRR using the truncated normal technique on targets of 11 by 11 samples of 4 km resolution global area coverage (GAC) data. Gross cloud detection requires that the AVHRR 11 micrometer channel and the HIRS/2 channel 8 (H8) (an 11 micrometer channel) not differ by more than 2 degrees C after correction for the average difference between the two channels (average difference is 1 degree C with the H8 being smaller than the AVHRR 11 micrometer channel). Also the difference between H8 and H7 must exceed 17 degree C. Primary cloud detection is performed with a discriminant classifier determined by regression using data from November 15 and 16, 1978. Coefficients of the discriminant classifier were determined by a global regression using the gross cloud tests to determine the clear targets. The discriminant functions are as follows:

Type 129 (AVHRR and HIRS/2 coincident data available)
D= -0.9963863E-02 (Climatology - 290)
+0.2248869E-01 (H8-H5)
+0.2171421E-02 (H10-H11)
-0.1852268E+00 (SEC sza -1)

Type 130 (AVHRR Data Only)
D= 0.2080572E-01 (AVHRR 11 micrometer Channel - Climatology)
+0.3665414E-02 (Climatology-290)
+0.4795260E-01 (SEC sza -1)

where SEC sza is the secant of the satellite zenith angle. All values in the discriminant equation are in K. Climatology is the nearest 1 degree latitude/longitude grid point climatological SST value for the month. The value of D must be between 0.98 and 1.20 for the target to be classified as clear. Clear 11 micrometer equivalent black body temperatures are then corrected for the effects of atmospheric attenuation by using a regression equation derived from data for November 15 and 16, 1978.

Using Northern Hemisphere Climatology for the ground truth data, the atmospheric attenuation correction equations are as follows:
Type 129 (Coincident AVHRR and HIRS/2 Data)
DELTA T = -0.1498916E+02
+0.4699983E-01 (100 km Field SST)
+0.1256545E+00 (100 km Field SST - H11)
+0.1047428E+01 (SEC sza -1)

Type 130 (AVHRR Only)
DELTA T = -0.3155946E+02
+0.1177870E+00 (100 km Field SST)
+0.1686770E+01 (SEC sza -1)

The 100 km and 50 km fields were initialized with December climatology.

January 1, 1979
End-of-Year problems caused some directory errors in the 7-day observation archive file for this week.

February 1, 1979
Observations in the tropics are generally over 1 degree C too low. The cause is residual cloud contamination, and it was decided to incorporate a neighbor check to eliminate cloud contaminated observations. Began neighbor check procedure for all observations between 20 degrees north and south. Each observation is compared with an average temperature of surrounding observations. The observation is rejected if it differs from the average by more than 1 degree C.

February 28, 1979
Formal end of ITOS operation. TIROS-N is designated as the operational satellite. The TIROS-N SST archive, however, will be maintained beginning January 1, 1979.

May 9, 1979
Terminated neighbor check procedure in the tropics. Substituted stricter discriminant function limits when the SST is above 297 K. The stricter limits are 1.02 to 1.20.

June 10, 1979
Repaired a logic problem in the SST retrieval module which prevented the retrieval of SST's in the vicinity of the Date Line.

June 27, 1979
Launch of NOAA-A, designated NOAA-6 in orbit. This is the second satellite in the TIROS-N series.

November 1, 1979
Beginning in mid April and continuing until Fall, accuracy above 30 degree North latitude is poor. Current regression equations overcorrect for atmospheric attenuation in the high latitudes in the summer hemisphere. Also, SST's in the vicinity of the northwest coast of Africa are too high.

January 1, 1980
Heat budget analysis scheme changed. Mercator fields are now produced from the polar stereographic fields. During 1979, the stereographic fields were derived from the Mercator fields.

January 20, 1980
An on-board computer failure terminates TIROS-N data reception.

January 22, 1980
The NOAA-6 satellite, the second satellite in the TIROS-N series, is designated as the operational satellite.

January 25, 1980
Began calculating SST's from NOAA-6 satellite. Regression coefficients were calculated from January 22 and 23 data using Northern Hemisphere January climatology as ground truth. Gross cloud detection tests are the same as TIROS-N. Discriminant classifier is as follows:

Type 129 (Coincident AVHRR and HIRS/2)
D= -0.68785E-02 (Climatology - 290)
  +0.23452E-01 (H8-H5)
  +0.16013E-02 (H10-H11)
  -0.17712E+00 (SEC sza -1)

Type 130 (AVHRR only) Not Used

All temperatures are in K. Climatology is the nearest 1 degree latitude/longitude grid point climatology value for the month.

Atmospheric attenuation correction equation was obtained by regression using Northern hemisphere climatology for January as ground truth. The atmospheric attenuation correction equation is:

Type 129 (Coincident AVHRR and HIRS/2)
DELTA T = -0.19640E-02 + 0.60360E-01 (100 km Field SST)
  +.15323E+00 (100 km Field SST - H11)
  +0.21380E+01 (SEC sza -1)

Type 130 (AVHRR only) Not Used

January 28, 1980

Observation accuracy has been degrading during the last few days. The problem has been traced to the regression equation.

January 29, 1980
Changed regression for atmospheric attenuation correction. Ground truth was changed to the 100 km field analysis temperature in the Northern hemisphere for January 20, 1980. The new regression equation is as follows (Discriminant function was not changed):

Type 129 (Coincident AVHRR and HIRS/2)
DELTA T = -0.2067618E+02
+0.6683129E-01 (100 km SST)
+0.1394463E+00 (100 km SST - H11)
+0.2606292E+01 (SEC sza -1)

April 29, 1980
A slight increase in the IR channel space view noise has caused the loss of up to 16 percent of the data since April 11, 1980. The upper limit of the space view variance was increased from 1 to 2 counts to accept the noisier data.

April 30, 1980
The threshold of the gross cloud detection test (the difference between HIRS channel 8 (the window channel) and channel 7 (the lower tropospheric channel), was decreased from 17 degree C to 15 degree C. This essentially relaxes the cloud test at high latitudes where it has been too restrictive (especially with the NOAA-6 data).

May 2, 1980
Version 2.0 of the Heat Budget data reduction module was implemented. This version allows correct day/night decision in the creation of flux fields using data from a morning satellite.

August 5, 1980
Implemented new cloud discrimination coefficients based on data passing the 15 degree gross cloud test. The discriminant equation is now:
D= -0.78161E-02 (Climatology - 290)
+0.22398E-01 (H8-H5)
+0.41897E-02 (H10-H11)
-0.15995E+00 (SEC sza -1)

The minimum threshold for D above 290 K surface temperature is 1.03, for the rest of the Southern hemisphere it is 0.99, for the rest of the Northern hemisphere it is 0.98, (sza is the Satellite zenith angle).

August 6, 1980
Implemented a bias correction to correct for the warm bias in high latitudes of the summer hemisphere. The correction C is calculated as follows and added to the calculated SST. C = Table Value - (H8-H7) where H8 and H7 are the temperatures sensed in HIRS channel 8 (the window channel) and 7 (the lower tropospheric channel). This correction is thus proportional to

the lapse rate in the lower troposphere. The table value is a function of the calculated SST before correction. The table is as follows:

SST	Bias Correction	SST	Bias Correction	SST	Bias Correction
270	14.5	280	16.6	290	19.3
271	14.6	281	16.9	291	19.4
272	14.8	282	17.0	292	19.5
273	14.9	283	17.3	293	19.6
274	15.1	284	17.4	294	20.0
275	15.4	285	17.8	295	20.5
276	15.6	286	18.4	296	20.8
277	15.8	287	18.9	297	21.1
278	16.0	288	19.0	298	21.3
279	16.3	289	19.1	299	21.0

August 26, 1980
It was discovered that the maximum atmospheric correction allowed is 8 degrees C. Areas in the western tropical Pacific regularly have corrections greater than 8 degrees C. Corrections as high as 15 degrees will be allowed for generating a regression tape used to calculate the atmospheric correction coefficients. The limit will continue to be 8 degrees C in the operational processing of SST.

January 20, 1980
An undetected disk I/O error on Thursday, November 20 resulted in a heat budget observation dated July 28, 1984. Daytime longwave flux and absorbed solar energy analyzed fields were set up for the erroneous date, interfering with the daily field analysis for the next three days. To solve the problem, the field files were initialized. Nighttime longwave flux fields were not affected by the erroneous observation; however, 10 hours of nighttime data were lost in the field initialization.

January 31, 1980
Eight hours of data were lost due to an incorrect manual entry of the date on the preprocessing computer.

January 24, 1981
The heat budget absorbed field was incorrect from January 17-24, 1981 due to a bad program load module.

January 26, 1981
An error in the IBM 360 CPU resulted in loss of the 100 km SST analyzed field. The field for January 25, 1981 was reloaded and the field generation program was rerun. An incorrect data card did not allow any inclusion in this field of data from January 25, 1981.

February 6, 1981

The heat budget product network was run after midnight resulting in the calculation of a heat budget analyzed field for the wrong date. The backup program was run too late. The field for February 4, 1981 was lost.

August 19, 1981
The operational spacecraft was switched from NOAA-6 to NOAA-7. Three weeks of operational parallel testing were conducted before the switch. Regression equations were calculated using data collected between July 21, 1981 and July 23, 1981. Atmospheric attenuation regression coefficients were calculated using the NOAA-6 satellite 100 km analyzed field as ground truth. The gross cloud tests remain identical to NOAA-6. The NOAA-7 cloud discriminant function is:

D = -.005565330 (Climatological SST - 290) + .02280071 (H8-H5)
+.002125098 (H10-H11) -.1565646 (SEC sza-1)
where sza is the Satellite zenith angle. The atmospheric attenuation equation for NOAA-7 is:

DELTA T= -13.37065
+.03274177 (100 km analyzed field SST)
+0.2143435 (100 km analyzed field SST - H11)
+0.9215280 (SEC sza -1)

The bias correction was also changed for NOAA-7 and is being applied only in the Northern hemisphere. The bias values are now:

SST	Bias Correction	SST	Bias Correction	SST	Bias Correction
270	14.5	280	16.6	290	19.2
271	14.6	281	16.9	291	19.4
272	14.8	282	17.0	292	19.4
273	14.9	283	17.3	293	19.4
274	15.1	284	17.4	294	19.6
275	15.4	285	18.6	295	20.5
276	15.6	286	19.3	296	20.7
277	15.8	287	19.7	297	21.9
278	16.0	288	19.7	298	21.2
279	16.3	289	19.3	299	20.9

August 25, 1981
Most of the observations for August 24, 1981 and August 25, 1981 had to be purged. A faulty disk pack resulted in erroneous calibration coefficients and thus erroneous observations. The NESDIS archive will not contain any erroneous data.

September 17, 1981
Calibration coefficients are erroneous for data from 0000Z to 2119Z. Bad data was purged from the archive.

September 28, 1981
Calibration coefficients are erroneous for data from 0018Z to 1407Z. Bad data was purged from the archive.

November 17, 1981
The operational technique for calculating sea surface temperatures was changed to a multichannel technique. Separate algorithms are used for day and night observations. The algorithm is denoted by the observation type. Type 151 is daytime operational observations derived from the AVHRR instrument alone. Type 152 is nighttime AVHRR operational observations. Daytime sea surface temperatures are calculated with a split-window quadratic equation. The new equations for NOAA-7 are:

$$SST=1.046(T11) + 1.666(T11-T12) + 0.528(T11-T12)(T11-T12) - 286.48$$

where SST = sea surface temperature in Centigrade, T11=11 micrometer AVHRR Channel temperature in Kelvin, and T12=12 micrometer AVHRR Channel temperature in Kelvin. Nighttime sea surface temperatures are calculated with a triple window equation:

$$SST= 1.0224(T11) + 1.00144(T3.7-T12) -278.515$$

where terms are the same as the daytime equation and T3.7=3.7 micrometer AVHRR channel temperature in Kelvin. Sea surface temperatures are calculated from 8 km resolution areas spaced about 25 km apart from all regions of the global ocean and the larger inland seas such as the Caspian sea.

Two additional equations are used at night for cloud tests and intercomparison tests:

NIGHTTIME SPLIT-WINDOW

$$SST=1.07226(T11) + 1.7085(T11-T12) + 0.542(T11-T12)(T11-T12) - 294.27$$

NIGHTTIME DUAL-WINDOW

$$SST=1.0574(T11) + 1.5044(T3.7-T11) - 287.76$$

November 24, 1981
Changed precision of AVHRR daytime operational equation. New equation is as follows:

$$SST= 1.0460(T11) + 1.6662(T11-T12) + 0.5285(T11-T12)(T11-T12) - 286.4595$$

November 27, 1981
A system error resulted in no SST observations for November 25, 1981.

November 30, 1981
The first monthly mean charts containing multichannel observations are dated November 30, 1981. These charts are derived partly from SSTs calculated with the former operational technique and partly from the multichannel observations.

December 2, 1981

Implemented a low stratus nighttime cloud test. T11-T3.7 is not allowed to be greater than 0.7 degrees Centigrade.

December 31, 1981
Produced the first monthly mean charts derived solely from multichannel data.

February 23, 1982
Changed daytime operational equation to a split-window linear equation:

SST= 1.0351(T11) + 3.046(T11-T12) - 283.9267
Began calculating 8 km density observations off Peru, in Gulf of Mexico, and off the East Coast of the United States.

May 25, 1982
Changes were made to the regions covered by some of the 50 km SST analyzed fields and the contour charts produced from these fields.

June 22, 1982
Starting in June 1982, the AVHRR 3.7 micrometer channel became progressively noisier. The presence of noise caused some of the cloud detection tests to fail. With this failure, erroneously low temperatures were introduced into the SST field analyses.

September 14, 1982
Changed analysis parameters in 100 km and 50 km analyzed fields to (1) Make the analysis search area smaller, (2) Tighten the gradients, (3) Give observations near a grid point a greater weight, (4) Accentuate 5 degree contours, and (5) Use more accurate land/sea tags. A visible cloud threshold table is now being used for cloud discrimination during the day. This table was derived with channel 2 albedos from January 1982.

September 15, 1982
Changed nighttime operational equation to one derived with corrected NOAA-7 filter functions and a larger set of buoys to derive a bias correction (second bias correction). The operational nighttime equation is the Nighttime Triple Window SST equation. The daytime equation was unchanged.

NIGHTTIME TRIPLE WINDOW SST:
SST = 1.0239 (T11) + 0.9936 (T3.7-T12) - 278.46

NIGHTTIME SPLIT WINDOW SST:
SST = 1.0527 (T11) + 2.6272 (T11-T12) - 288.23

VOLCANO TRIPLE WINDOW SST:
SST = 1.9708 (T3.7- T11) + .9675 (T12) -260.46

The volcano triple window SST equation proved to be erroneous and was changed on 1/24/83.

October 13, 1982
The noise in channel 3 (3.7 micrometer channel) has increased substantially during the last few months. The channel 3 uniformity test was turned off to obtain more coverage.

October 27, 1982
Noise in Channel 3 has caused loss of both day and night data. Increased noise limit so data will not be lost during the day and put in a 15 count Channel 3 uniformity test at night.

November 1, 1982
Errors uncovered in the daytime search pattern were fixed. Observation density is now increased in high density areas.

November 17, 1982
Changed nighttime operational algorithms to use a 4 x 4 unit array (i.e., make 16 km resolution SST's). This is an increase from the normal 2 x 2 (8 km) arrays. There is no channel 3 (3.7 micrometer channel) uniformity test and the channel 4 (11 micrometer channel) uniformity threshold is increased from 2 to 4 counts.

December 8, 1982
Increased density of observations along the U.S. West Coast.

December 15, 1982
Changed nighttime gross cloud test from channel 3 to channel 4. Increased the noise limit for Channel 3.

December 22, 1982
Lost all but one orbit during December 19-20, 1982. No observations were produced because calibration coefficients were in error.

January 24, 1983
Changed one of the SST intercomparison test equations from the volcano triple window to the dual window equation.

DUAL WINDOW SST:
SST = 1.0063 (T3.7) + 0.4481 (T3.7-T11) - 272.47

February 3, 1983
Changed the daytime multichannel equation to the second bias correction version.

DAYTIME SPLIT-WINDOW
SST=1.0209(T11) + 2.5438(T1-T12) - 279.23

March 1, 1983
Implemented new coefficients for radiation (Heat) Budget calculations.

May 10, 1983

Began using high resolution land/sea tags around U.S. coast. Observations can now be obtained as close as 10 km to land (closest observation allowed previously was 50 km to land). Changed daytime SST search pattern in the observation calculation to prevent duplicate observations from adjacent targets.

July 25, 1983
Electronic interference in the 3.7 micrometer channel (channel 3) has decreased the accuracy of nighttime observations. No more nighttime observations will be produced.

August 2, 1983
Updated radiation budget coefficients.

August 14, 1983
Implemented the relaxed visible cloud threshold test in the daytime algorithm. If no observations are obtained with the normal daytime algorithm, a search is made for the warmest spot, the IR channel 4 uniformity test (2 count threshold) is performed along with the visible channel 2 uniformity test and the visible cloud threshold is relaxed by multiplying it by 1.5. Many more daytime observations are produced with this procedure.

August 23, 1983
Added high density observation areas along the Alaskan coast, the entire Gulf of Mexico, the East Coast of Australia, and the Coast of South Africa.

September 20, 1983
AVHRR IR channels on NOAA-7 turned off for outgassing. No SST's will be produced for a week.

September 27, 1983
AVHRR NOAA-7 IR channels turned on at 1328Z. The noise in channel 3 was reduced from 16 counts to 1.36 counts.

September 28, 1983
NOAA-7 SST made operational at 2200Z for both day and night data. No radiation budget field was produced for September 27, 1983.

October 6, 1983
A disk crash resulted in the loss of 3 days of 100 km analyzed fields.

October 10, 1983
Reliability of daytime and nighttime observations have now been made equal. Previously the nighttime reliability factor was only 3/4 of the daytime factor. This reliability factor is used in the field analyses. The accuracy of the nighttime rms differences against buoys are under 1 degree C.

November 29, 1983
Implemented a new multichannel equation for daytime observations. This is the third bias

correction equation:

SST= 1.0346 (T11) +2.5779 (T11-T12) - 283.21

December 1, 1983
Added Japanese Coast, Mediterranean, Hawaii to areas with high-resolution land/sea tags and high-density observations.

December 9, 1983
Took out Hawaii high-density observation area. Too many observations are being produced in this clear area. The limits of the current system have been reached.
December 13, 1983
Took out part of Sargasso Sea high-density observation area.

February 1, 1984
Changed nighttime multichannel equations to use the third bias corrected equations. The equation used for operational SST is the triple window equation:

TRIPLE WINDOW SST:
SST= 1.0170 (T11) + 0.9694 (T3.7-T12) -276.58
The other two equations used in the SST intercomparison test are:
DUAL WINDOW SST:
SST= 1.5018 (T3.7) - 0.4930 (T11) - 273.34
SPLIT WINDOW SST:
SST= 3.6139 (T11) - 2.5789 (T12) -283.18

February 24, 1984
Nighttime SST data lost during much of the period February 17-24, 1984 because calibration coefficients were inaccurate due to warming of the AVHRR to reduce jitter.

March 28, 1984
Changed daytime multichannel algorithm to process AVHRR data out to 53 degree satellite zenith angle (an increase from 45 degree).

July 25, 1984
Changed reflectance threshold for day/night determination from 10 percent to 1 percent. For targets with Solar Zenith angles between 75 and 90 degrees, the nighttime algorithm will be used if the reflectance in channel 2 is less than 1 percent. Otherwise the target will not be processed at all. Targets with Solar Zenith less than 75 degrees will always be processed with the daytime algorithm. Targets with Solar Zenith greater than 90 degree will always be processed with the nighttime algorithm.

August 16, 1984
Changed nighttime algorithm to use a 3 x 3 unit array (instead of a 2 x 2) and a uniform low stratus threshold of 0.4 degrees.

November 1, 1984
Terminated production of 500 km SST field. The October 1984 archive tape (written on November 2, 1984) is the last tape to contain a file of 500 km fields.

November 19, 1984
Removed a software error in the observation archive program. Some high density blocks for the past year and a half contain old data. These blocks have been cleaned up and the problem should not recur.

December 9, 1984
On 12/5 the NOAA-7 spacecraft was given an incorrect command which caused the satellite to tumble. The spacecraft was not recovered until late on December 8. Test SST's were generated for a day, then made operational on December 9.

December 12, 1984
Launch of NOAA-9.

December 15, 1984
NOAA-7 AVHRR was heated causing loss of data due to calibration problems from late December 14, 1984 to late December 15, 1984. Calibration has returned to normal.

January 2, 1985
On December 31, 1984 the navigation data for the AVHRR had a 9 second error. All SST observations were mismapped by 54 km. Incorrect observations were sent out on the GTS. On January 2, 1985, observations from December 31, 1984 were purged from the observation archive file. The mislocated observations are not on the 7-day observation archive tape.

February 5, 1985
NOAA-9 became the operational satellite for SST and radiation budget. The Radiation Budget coefficients are:
ACOF=-4.454, BCOF=1.2409, CCOF=-.001083

The SST equations are (first bias correction):
DAYTIME SPLIT WINDOW:
SST= 3.6569 (T11) - 2.6705 (T12) - 268.92

NIGHTTIME TRIPLE WINDOW:
SST= 0.9825 (T3.7) + 0.9936 (T11) - 0.9825 (T12) - 269.66

The two other equations used in the nighttime intercomparison test are:
NIGHTTIME SPLIT WINDOW:
SST= 3.6836 (T11) - 2.690 (T12) - 270.42

NIGHTTIME DUAL WINDOW:
SST= 1.4951 (T3.7) - 0.5015 (T11) - 269.13
where SST is the sea surface temperature in Centigrade, T3.7, T11, T12 are the 3.7, 11, 12 micrometer temperatures in Kelvin, respectively.

April 8, 1985
Began processing orbital data sent via an intercomputer link between the new METSAT DPSS IBM 4300 series ingest system and the mainframe NAS 9050/ 9070 computers. The 4300 computers are used to preprocess the data and the 9050/9070 are used for product production.

July 1, 1985
Began operational orbital processing of NOAA-8 radiation budget in addition to NOAA-9.

July 29, 1985
Started using new Uniform Low Stratus Cloud Test in the SST operation: (T12-T3.7) must be less than -0.6K to calculate an SST at night. The test used previously was (T11-T3.7) must be less than 0.7K to calculate an SST at night.

September 9, 1985
Stopped processing NOAA-8 data when the spacecraft oscillator malfunctioned.

September 16, 1985
Started processing NOAA-8 data once again for radiation budget.

September 21, 1985
NOAA-8 earth location incorrect.

September 28, 1985
Terminated processing of NOAA-8 data - oscillator malfunctioned again.

October 3, 1985
Began direct ingest of NOAA-9 data on the new METSAT DPSS ingest system hardware. Up until this time data were ingested on the old SEL 32/55 computers.

October 8, 1985
Started using daytime split window equation with 2nd bias correction:

DAYTIME SPLIT WINDOW:
SST = 3.6446 (T11) -2.6616 (T12) - 267.96

October 15, 1985
The maximum satellite zenith angle was increased from 45 degrees to 53 degrees for nighttime satellite SST observations.

October 28, 1985
Nighttime algorithm now uses the 2nd bias corrected multichannel SST equations along with terms containing the satellite zenith angle (sza). The maximum zenith angle used for SST has been increased from 45 to 53 degrees in both the daytime and the nighttime algorithms.

NIGHTTIME TRIPLE WINDOW:

$$SST = 0.9946\,(T3.7) + 1.0059\,(T11) - 0.9946\,(T12) + .465\,(T3.7)(SEC\ sza\text{-}1) - .465\,(T12)\,(SEC\ sza\text{-}1) + .403\,(SEC\ sza) - 273.923$$

The two other equations used in the nighttime intercomparison test are:

NIGHTTIME SPLIT WINDOW:

$$SST = 3.7028\,(T11) - 2.704\,(T12) - .27\,(T11)\,(SEC\ sza\text{-}1) + .27\,(T12)\,(SEC\ sza\ \text{-}1) + .738\,(SEC\ sza) - 273.418$$

NIGHTTIME DUAL WINDOW:

$$SST = 1.5249\,(T3.7) - .5115\,(T11) + .958\,(T3.7)\,(SEC\ sza\text{-}1) - .958\,(T11)\,(SEC\ sza\ \text{-}1) + 1.55\,(SEC\ sza) - 276.57$$

In all these equations, SEC sza is the secant of the Satellite zenith angle.

December 7, 1985
Twelve hours of data were lost due to lack of disk space in the SST observation file.

December 31, 1985
The last 2.5 degree latitude/longitude monthly mean contour charts were produced for the month of December 1985. This terminates this product. It has been replaced with monthly mean SST charts produced by the NOAA Climate Analysis Center.

January 1, 1986
Changed format of all hardcopy SST charts. All charts are now produced as single charts rather than a collection of chartlets which must be assembled to form the finished chart. The 14 km charts became operational and are now being produced twice each week and archived to tape once a month. These high resolution charts cover the contiguous U.S. coastline. Monthly mean charts have been discontinued, however, digital monthly mean fields still continue to be archived. The resolution of the monthly mean field being contoured will be increased from 2.5 to 2.0 degree latitude/longitude squares.

February 4, 1986
Some data lost due to tape recorder problems at Wallops CDA station.

February 5, 1986
Some data lost due to tape recorder problems at Wallops.

February 10, 1986
Some data lost due to frame sync errors at Wallops.

February 18, 1986
Some data lost due to frame sync errors at Wallops.

March 24, 1986
The Multi-channel Sea Surface Temperature (MCSST) production was down from 8:15 pm Local March 13 to 1:00 am March 16 due to water damage in NESDIS computer room. Lost partial data for March 14 and all data for March 15.

August 4, 1986
Changed the format of the weekly satellite SST Observation File to satisfy requirements of the Tropical Ocean and Global Atmosphere (TOGA) project.

September 17, 1986
Launched NOAA-10, satellite ID (8), descending morning. This satellite will be used initially only for radiation budget products - not MCSST products.

October 6, 1986
Implemented the non-linearity calibration corrections for AVHRR channels 4 and 5 for NOAA-9. The AVHRR calibration was changed to use a zero radiance of space instead of a negative radiance of space. The equations are as follows (note: sza is Satellite zenith angle):

DAY SPLIT
SST = 3.6446(T11) - 2.6616(T12) - 267.96

NIGHT SPLIT
SST = 3.7228(T11) - 2.7186(T12)
-0.27(SEC sza -1) x (T11-T12) +0.738(SEC sza -1)-274.3641

NIGHT DUAL
SST = 1.5331(T3.7) - 0.5143(T11) + 0.958(SEC sza-1)(T3.7-T11)
+1.550(SEC sza-1) - 276.7163

NIGHT TRIPLE
SST = 1.0113(T11) + 0.9999(T3.7-T12) +0.465(T3.7-T12) (SEC sza-1)
+ 0.403 (SEC sza-1) - 274.9957

November 7, 1986
NOAA-9 calibration was changed back to using a negative artificial radiance by mistake. No change was made in MCSST equations. MCSST accuracy was degraded.

December 10, 1986
Began processing Radiation Budget from NOAA-10 Level 1b AVHRR data operationally. The histogram classes for the Outgoing Longwave Radiation (OLR) data for NOAA-10 are:
1st class interval = values greater than 174
2nd class interval = values from 136 through 174
3rd class interval = values less than 136

Changed to the following:
Class 1 < 107
107 < Class 2 < 131
Class 3 > 131
Histogram Threshold value 174,136

Coefficients

ACOF = 4.092BCOF = 1.1904 CCOF = -.001025

December 15, 1986
Started generating 50 km SST Analysis Fields twice a week instead of once a week.

January 10, 1987
A new high-density SST area was added to the SST operation for the region 60N to 80N latitude and 40W to 10E longitude.

January 20, 1987
Changed the SST unit array size for cloud detection and SST averaging at night from 2X2 to 3X3. Added a new day and night SST cloud test to reject very large T11-T12 differences which occur with thin cirrus clouds and cloud edges. This test rejects the unit array if (T11-T12) >3.5K. During the day, a second new test rejects unit arrays if T11<270K.

February 11, 1987
The NOAA-9 AVHRR resynced between 1548Z and 1720Z. One orbit was affected.

March 23, 1987
Implemented an updated version of the AVHRR orbital processing program to correct errors in the radiation budget flux summary subroutine.

April 6, 1987
Changed the NOAA-9 SST unit array from 3X3 to 2X2 for the nighttime algorithm.

April 7, 1987
Implemented changes to the program which generates the WMO satellite observation product which goes out on the GTS. Header product identifier codes were changed and the satellite identifier was changed from 36 to 34 for NOAA -9 and from 37 to 35 for NOAA-10.

April 10, 1987
Twelve orbits were lost during the last 3 days due to AVHRR sync problems. A manual resync was done on orbit 6263.

April 19, 1987
SST unit array size was changed from 2X2 to 3X3 because of high noise levels.

May, 1987
In the aerosol experimental product, changed the triple minus split cloud screening threshold to 5 degrees Kelvin to keep the Saharan dust from being called cloud.
June, 1987
Weekly composite contour maps of aerosol optical thickness over the oceans began being archived at NOAA/NCDC, Asheville, NC. Also, aerosol optical thickness began being stored in the satellite observation files of the TOGA MCSST Observation File Tapes at NCDC (8-day Observation File).

July 16, 1987
Implemented new NOAA-9 bias corrected equations for day and night. This corrects most of the MCSST accuracy degradation caused by the calibration procedure using a negative radiance of space.

DAY SPLIT
SST = 3.4317(T11) - 2.5062(T12) - 251.2163

NIGHT SPLIT
SST = 3.6037(T11) - 2.6316(T12) - .27(T11-T12) x (SEC sza -1)
+0.738(SEC sza-1) - 265.0117

NIGHT DUAL
SST = 1.484(T3.7) - 0.4978(T11) + 0.958(T3.7-T11) x (SEC sza-1)
+1.55(SEC sza-1) - 267.2916

NIGHT TRIPLE
SST = 0.9679(T3.7) + 0.9789(T11-T12) + 0.465(T3.7-T12) x (SEC sza-1)
+ 0.403(SEC sza-1) - 265.6235

July 30, 1987
All oceanographic product system processing was down from 2300 Local July 27, 1987 to 1200 Local on July 29, 1987 due to computer outage (thunderstorm).

September 10, 1987
A revised NOAA-9 AVHRR orbital processing program was implemented with some aerosol changes. The following changes were made:

1) Required azimuth greater than or equal to 140 degrees
2) Changes Optical Thickness (OT) scale for Griggs' table from 0.213 to 0.244.
3) Required OT less than 2.44
4) Implemented Earth/Sun distance correction to Channel 1 radiance.

October 8, 1987
A revised NOAA-10 AVHRR orbital processing program was implemented with changes to the radiation budget flux summary subroutine.

October 16, 1987
Changed NOAA-9 calibration back to zero radiance of space. Calibration is now correct; however MCSST accuracy is degraded again since MCSST equations were not changed.
January 1, 1988
Problems were encountered in the ingest software resulting from end of year switch over. This resulted in gridding errors (on the GELDS tapes) for approximately 27 hours and partial loss of Level 1b data. There were 25 minutes of NOAA-9 data and over four hours of NOAA-10 data lost on January 1, 1988. The affected GELDS tapes were regenerated with the correct grid information.

January 4, 1988
The Ingest Systems Branch discovered another gridding problem. This problem involved the calculation of the rotation of the Earth (Greenwich Hour Angle). It was corrected operationally starting with orbit 15782 for NOAA-9 and orbit 6747 for NOAA-10.

January 28, 1988
Implemented new coefficients for all MCSST equations for NOAA-9 day split and night dual. SST accuracy is improved since correctly calibrated channel values were used in the generation of these equations, and they are used with correctly calibrated data.

DAY SPLIT
SST = 3.6084(T11) - 2.6353(T12) - 265.4789

NIGHT DUAL
SST = 1.5258(T3.7) - 0.5118(T11) +0.958(T3.7-T11) x (SEC sza-1)
+ 1.55 (SEC sza -1) - 275.3739

February 25-28, 1988
Communications were out between SOCC and the CDA in Gilmore Creek, AK which resulted in the loss of approximately 50% of the Level 1b GAC data for the NOAA-9 and NOAA-10 satellites.

March 30, 1988
Implemented new equations for NOAA-9 night split and night triple. MCSST accuracy back to normal for day and night measurements.

NIGHT SPLIT
SST = 3.7051(T11) - 2.7057(T12) - 0.27(T11-T12) x (SEC sza-1)
+ 0.73(SEC sza-1) - 273.0323

NIGHT TRIPLE
SST = 0.9951(T3.7)+1.0065(T11) - 0.9951(T12)
+ 0.465(T3.7-T12)x(SEC sza-1) + 0.403(SEC sza-1) - 273.661

March 1988
To fix the overestimate of Optical Thickness (OT) over open oceans in the aerosol experimental product, implemented the following:

1) Removed Channel 1 radiance offset (set to 0) and 2) Set OT =0 if OT less than 0.

May 1, 1988
Implemented reflectance models in processing radiation budget. Used weighted combination of Channels 1 and 2 with bidirectional and directional models.

August 11, 1988
Changed climatology test threshold for NOAA-9 from 7 to 10 degrees for all algorithms.

August 15-23, 1988

No AVHRR Level 1b IR channels archived.

August 31, 1988
Changed NOAA-9 unit array size to 3x3 for nighttime algorithm.

September 24, 1988
Launch of NOAA-11.

September 27, 1988
Turned off archive of ship observations in the TOGA SST Observation File Archive.

October 19, 1988
Changed unit array size for NOAA-9 to 2x2 at night.

November 1, 1988
All Level 1b data lost for all three satellites (NOAA-9, NOAA-10, and NOAA-11) from October 29 1545Z to October 30 0314Z due to ingest computer problems.

November 8, 1988
NOAA-9 turned off. NOAA-11 became operational satellite for producing SST, Radiation Budget, and Experimental Aerosol. Equations being used are listed under November 17, 1988 entry. The Nighttime Thermal IR Cloud Tests, which compared the actual T3.7 and T11 temperatures with values predicted from T11 and T12 temperatures, respectively, were discontinued. The aerosol product continued to use NOAA-9 (Griggs') table look-up code.

November 14, 1988
Lost MCSST observations for 3 days November 11-13, due to disk file problem.

November 17, 1988
Implemented MCSST equations and corrected central wave numbers for NOAA-11. These equations were derived using data corrected with the original non-linearity calibration correction tables for channels 4 and 5. These tables were obsolete and were updated just prior to launch of NOAA-11. The original tables were used, however, until September 27, 1989. If these equations are used with AVHRR data corrected with the original non-linearity tables, the resulting SST's are correct.

DAYTIME:
SPLIT-WINDOW MCSST

$$SST = 0.9712(T11) + 2.0663(T11-T12) + 1.8983(T11-T12) \times (SEC\ sza-1) -1.9790(SEC\ sza-1) -264.79$$

NIGHTTIME:
SPLIT-WINDOW MCSST

$$SST = 0.9843(T11) + 2.0942(T11-T12) + 2.0994(T11-T12) \times (SEC\ sza-1) - 1.1838(SEC\ sza-1) - 268.74$$

DUAL WINDOW MCSST

$$SST = 1.00036(T11) + 1.6879(T3.7-T11) + 0.2550(T3.7-T11)x(SEC\ sza-1) + 1.4995(SEC\ sza-1) - 271.25$$

TRIPLE WINDOW MCSST

$$SST = 0.9900(T11) + 0.9528(T3.7-T12) + 0.6335(T3.7-T12)x(SEC\ sza-1) + 0.5215(SEC\ sza-1) - 269.22$$

December 21, 1988
Turned on flag to append HIRS data for day and night algorithms for NOAA-11 SST observations.

December, 1988
Satellite observation files with aerosol optical thickness appended (in the same format as the SST 8-day Observation File) began to be stored on separate Aerosol Observation File Tapes at NCDC.

January 16, 1989
Switched to the NOAA-11 aerosol look-up table (STX Dave Code) but had errors in the code.

1) Removed azimuth greater than or equal to 140 degree requirement
2) Set Optical Thickness (OT) = 0.213 for normalized value

January 19, 1989
Corrected error in aerosol code implemented on 1/16/89. Chart quality is poor. Discovered striping in charts over open ocean tropics. Appeared to be orbit related. Concluded that it was due to specular reflection. Discovered that the STX code should be normalized to OT=0.198, rather than OT=0.213.

January 26, 1989
Changed the threshold values for the three histogram class intervals for NOAA-11 in the Radiation Budget.

Class 1 < 123
123 < Class 2 < 151
Class 3 > 151
Histogram class thresholds are changed as follows:
NOAA-11 174,136 to 151,123
NOAA-10 151,123 to 131,107

February 2, 1989
Stopped appending HIRS data for daytime algorithm for NOAA-11.

February 16, 1989
To fix the aerosol problems found on 1/19/89, the following was implemented:

1) OT=0.198 for normalized value.
2) Satellite zenith angle less than 70 degrees (was < 53 degrees); this fills gaps in seven

day coverage)
3) GAMMA (half angle of specular reflection cone) must be greater than 40 degrees.

March 2, 1989
Found error preventing the aerosol 53 degree cut-off from being replaced by 70 degrees, and fixed the error. However, other restriction in the data processing limit the maximum satellite zenith to 60 degrees.

March 9, 1989
NOAA-11 Visible Cloud Threshold Table implemented, replacing the NOAA-9 table. This is applicable to SST and aerosol operations.

March 13, 1989
Solar flare caused NOAA-10 and NOAA-11 to lose attitude control.

April 2, 1989
No TOVS Level 1b data archived. Computer clock problems caused by switch from EST to EDT.

April 5-6, 1989
Degraded S/N ratios for Wallops passes. Antenna undergoing maintenance work.

April 6, 1989
Power outage in DPSS from 0300-1600 Local time.

April 6, 1989
Changed research density from 15 SST observations per 1/2 target to 8 observations per 1/2 target for NOAA-11 daytime SST algorithm. Changed search pattern to correspond to this.

April 18, 1989
Began applying the triple minus split (TMS) test to 157 observations (operational SST observations) as has always been done with 158 observations in the aerosol operation. The Visible Cloud Threshold Table was relaxed by a factor of 8.

May 25, 1989
The Nighttime Outlier Rejecter Test was implemented in the SST operation. This cloud test, which follows all the others, is a joint test; i.e. <u>both parts</u> must fail for rejection of the observation:

Part 1 (HIRS TEST): [3.5-0.2333(HIRS8-HIRS7)+0.038446 x FLD
+ 1.612(SEC sza-1)]>0.25 fails the test
Part 2 (FIELD/CLIMATOLOGY TEST): [2 x (FLD-MCSST) + (CLIM - MCSST)]/3>3.0
fails the test
where:
FLD=the satellite 100 km analyzed field SST from the previous day.
CLIM = the current month's climatological SST value
SEC sza = secant of the Satellite zenith angle

HIRS8, HIRS7 = HIRS channel 6 and 19 temperature in K, respectively
MCSST = multichannel SST using the nighttime operational equation

May 31, 1989
NOAA-10 outgassing from May 30 through June 8. Turned off all Radiation Budget jobs for this time period. No data available during this time.

June 8, 1989
Changed NOAA-10 three class histogram threshold values from 131,107 back to 151,123 in the radiation budget system.

June 8, 1989
Turned all Radiation Budget jobs back on after outgassing of NOAA-10 satellite completed.

June 29, 1989
All tapes for SST Matchup Database (SSTMCH) from February 1982 to present, SST Independent Buoy Data (SSTIND) from November 1978 to present, and SST Statistics and Verification data (SSTSAV) from April 1979 to present were sent to SSB for permanent archiving. SSB will now receive the original tapes for these QC/Verification products.

July 25, 1989
A disk pack being used by an operational program was taken offline without prior notice. Impact of this was loss of SSTOBS being transferred over the GTS system to WMO. A new disk pack was put into place and new JCL built to correct problem.

July 28, 1989
Wallops CDA was hit by lightning. Did not receive any data from Wallops because of this.

July 1989
The monthly mean contour maps of aerosol optical thickness began to be archived at NCDC. Also, monthly Aerosol Analysis/Validation Tapes began being archived at NCDC. They contain: Daily Summary Files - statistics on each day's observations for 648 ten degree Lat/long boxes; Daily Extreme Event Files - each satellite observation file where optical thickness exceeds 0.2; Weekly Analyzed Field File - optical thickness analyzed at 110 km resolution (used to produce contour maps); Monthly Averaged Analyzed Field File - average of weekly field files; Validation File - contains satellite observation and ground-truth data files at times and locations where matches within 3 hours and 300 km have occurred.

August 8, 1989
Changed residence time of data in SST Matchup Database from 62 to 45 days due to space problems.

September 27, 1989
Implemented correct channel 4 (11 micrometer channel) non-linearity calibration lookup table along with new MCSST coefficients for NOAA-11. These new equations should be used with data calibrated with the correct non-linearity calibration table.

DAYTIME:
SPLIT-WINDOW MCSST
SST = 1.01345(T11) + 2.659762(T11-T12) + 0.526548(T11-T12)x(SEC sza-1) - 277.742

NIGHTTIME:
SPLIT-WINDOW MCSST
SST = 1.052(T11) + 2.397089(T11-T12) + 0.959766(T11-T12)x(SEC sza-1) - 288.670474

DUAL-WINDOW MCSST
SST = 1.03432(T11) + 1.347423(T3.7-T11) +0.953042(T3.7-T11)x(SEC sza-1) - 280.794042

TRIPLE-WINDOW MCSST
SST = 1.036027(T11) + 0.892857(T3.7-T12) + 0.520056(T3.7-T12)x(SEC sza-1) - 282.373967

Degrees Kelvin in and degrees Celsius out.

November 28, 1989
Implemented a revision of the SST orbital processing program which averages the on-board calibration target blackbody temperatures for the 11 and 12 micrometer channels (i.e., channels 4 and 5). Ten consecutive data points in each of 11 scans are averaged to a single count value which is then converted to temperature. The calibration blackbody temperatures are used in the non-linear calibration correction procedure.

November 28, 1989
Discontinued appending the HIRS channel data to the nighttime SST observations. Removed the latitude/longitude field printout program from the operational job stream, because this product is no longer required.

January, 1990
Aerosol Optical Thickness product was deemed "operational."

January 25, 1990
Began experimental operational production of a Hawaii 14 km analyzed SST chart covering the Hawaiian Islands.

February 26, 1990
Began using a channel 4 uniformity test in operational daytime algorithm.
The threshold for rejection is 2 counts.

March 2, 1990
Implemented new CPSST (Cross Product SST) algorithm and new cross product equations for NOAA-11 operational SSTs. T3.7, T11, T12 are AVHRR 3.7, 11 and 12 micrometer channel temperatures, respectively, in degrees Kelvin (i.e., temperatures in Channels 3, 4, and 5, respectively). A new daytime MCSST Intercomparison Test was also implemented. If the difference between the CPSST and MCSST exceeds 1.0 degree C, then the observation is

rejected.

CPSST DAY SPLIT
SST = [(0.19410(T12) - 48.15)/(0.20524(T12) - 0.17334(T11) - 6.25)]
x (T11 - T12 + 1.32) + 0.94575(T12) + 0.60(T11-T12) x SEC sza -1) + 12.16

CPSST NIGHT TRIPLE
SST = [(0.16949(T11)-54.11)/(0.20524(T12) - 0.07747(T3.7)-41.60]
x (T3.7-T12-6.73) + 0.97778(T11) + 1.41(SEC sza-1) + 14.17

CPSST NIGHT DUAL
SST = [(0.17115(T11) - 54.64)/(0.17334(T11) - 0.07747(T3.7)-30.94]
x (T3.7-T11-3.64) + 0.98737(T11) + 1.59(SEC sza-1) + 11.38

CPSST NIGHT SPLIT
SST = [(0.19817(T12) - 49.15)/(0.20524(T12) - 0.17334(T11) - 6.10]
x (T11-T12 +1.47) + 0.96554(T12) +0.96(T11-T12)(SEC sza-1)+6.02

Degrees Kelvin in and out.

April 18, 1990
Implemented new CPSST equations for NOAA-11.
Implemented the Thermal-IR Uniformity Test during the day. This test is the same as the nighttime test with the same name. If all the unit array T11 temperatures do not agree within 0.2K, then the unit array is rejected.

MCSST DAY SPLIT
SST = 1.0155(T11) +2.50(T11-T12) + 0.73(T11-T12)(SEC sza-1)-277.99

CPSST DAY SPLIT
SST = [(0.19069(T12)-49.16)/(0.20524(T12) - 0.17334(T11)-6.78)]
x (T11-T12+0.789) + 0.92912(T12) +0.81(T11-T12)(SEC sza-1) - 254.18

CPSST NIGHT TRIPLE
SST = [(0.16835(T11) -34.32)/(0.20524(T12)-0.07747(T3.7)-20.01)]
x (T3.7-T12+14.86)+0.97120(T11)+1.87(SEC sza-1) - 276.59

CPSST NIGHT DUAL
SST = [(0.17079(T11) - 58.47)/(0.17334(T11) - 0.07747(T3.7)-33.74)]
x (T3.7-T11-6.44) +0.98530(T11) +1.97(SEC sza-1) -257.28

CPSST NIGHT SPLIT
SST = [(0.19596(T12) - 48.61)/(0.20524(T12) -0.17334(T11)-6.11)]
x (T11-T12+1.46) + 0.95476(T12)+0.98(T11-T12)(SEC sza-1)-263.84
Degrees Kelvin in and Celsius out.

April 3, 1990
Changed the Phoenix target in the Target Matchup Data Base to 33.72N and -112.33W. Added two targets: 8.5N, 4.5E and 3.22N, 60.03W.

June 2, 1990
No data available for NOAA-11 0900-2400Z and NOAA-10 0600-2400Z caused by fire and power outage in SOCC.

June 4-7, 1990
Lost majority of SST observations for this period or inaccurate observations calculated with wrong coefficients. All aerosol observations lost for this period. Data lost due to incorrect job control language.

June 25, 1990
Began putting aerosol observations into SST Matchup Database.

July 2, 1990
Implemented new NOAA-11 radiation budget coefficients. These are:

	ACOF	BCOF	CCOF
OLD	-4.454	1.2409	-0.001087
NEW	-10.14	1.2681	-0.001117

July 11, 1990
Updated NOAA-10 orbital processing program to revise the calculation of available solar energy at the North Pole and the subroutine BTWEEN which decides whether a point is within a given geographic rectangle. Updated the NOAA-11 orbital processing program to correct an interchange of the snow and desert scene IDs and the subroutine BTWEEN. These changes affect the radiation budget system.

August 2, 1990
Began processing SSTs in high density mode (8 per target) for the region 10-30N and 10-40W, in order to obtain more aerosol Matchup observations.

September 27, 1990
In the aerosol operation, Channel 1 gain was lowered by 5% which increases the albedo in Channel 1 by 5%. Aerosol optical thickness will be increased by at least 5% after this date.

September 30, 1990
SST observations were lost during the period 9/28-9/30. The reason is unknown since all programs appear to be running correctly.

October 31, 1990
Changed the residence time of satellite-buoy matches from 45 days to 35 days.

November 22, 1990
Lost 15 orbits of NOAA-11 processing during the period 11/21-11/22. This was caused by a job control language error.

November 27, 1990
Updated the SST orbital processing program to include in the SST observation output, the calibration blackbody temperatures for the 11 and 12 micrometer channels (i.e., Channels 4 and 5). This will allow the channel temperatures stored in the observation output to be recorrected for non-linearity calibration errors, if a more accurate correction is ever developed.

January 7, 1991
Turned off the radiation budget system for NOAA-10 during outgassing.

January 15, 1991
Resumed NOAA-10 processing after outgassing which began 1/7/91.

January 31, 1991
After a successful parallel test, new SST cloud test thresholds were implemented operationally. These are:

T12-T3.7 low stratus test threshold = 0 degrees
SST intercomparison test threshold = 1.5 degrees
Satellite versus climatology comparison in HIRS cloud test,
threshold = 2.5 degrees

February 14, 1991
In the aerosol system, the Naval Research Lab equation for SST correction due to Saharan Dust replaced the Griggs' El Chichon temperature correction. Aerosol observations from this date forward will have corrected SST's using the new scheme. These corrected SST's are experimental. The equations are:

Old Griggs' equation:
DT = 0.084 + 6.32(tau)(SEC sza)
New NRL equation:
DT = 0.0 + 4.34(tau)(SEC sza)

where tau is the aerosol optical thickness measured by Channel 1 of the AVHRR.

March 27, 1991
Changed the aerosol SST correction coefficients to the following (this will affect aerosol SST observations only):
DT = 5.158 (Tau)(SEC sza) -0.3

April 10, 1991
Replaced the CPSST equations with the Non-linear SST (NLSST) equations based on February 1991 buoy matches. The NLSST DAY SPLIT is the operational equation during the day, and the NLSST NIGHT TRIPLE is the operational equation at night. The equations are:

NLSST DAY SPLIT
SST=0.94649(T11)+0.08412(Tsfc)(T11-T12)
+ 0.751(T11-T12)(SEC sza-1)-257.20

MCSST DAY SPLIT
SST=1.02455(T11)+2.45(T11-T12)+0.64(T11-T12)(SEC sza-1)-280.67

NLSST NIGHT TRIPLE
SST=1.0006T11+0.245(T3.7-T12)+0.02766(T3.7-T12)
+ 1.88(SEC sza-1)-272.36

NLSST NIGHT SPLIT
SST=0.96042(T11)+0.087516(Tsfc)(T11-T12) + 0.852(T11-T12)(SEC sza-1)-261.46

MCSST NIGHT DUAL
SST=0.99615(T11)+1.5866(T3.7-T11)+2.027(SEC sza-1)-270.20

MCSST NIGHT TRIPLE
SST=1.00946(T11)+1.041(T3.7-T12)+1.76(SEC sza-1)-275.2

where MCSST = linear multi-channel SST algorithm
NLSST=non-linear SST algorithm
Tsfc= 100 km analyzed field temperature from the previous day
SEC sza = secant of the Satellite zenith angle
T3.7, T11, T12 are the AVHRR channel brightness temperatures in Kelvin
SST is the sea surface temperature in degrees Centigrade
SPLIT = using the 11 and 12 micrometer channels
DUAL = using the 3.7 and 11 micrometer channels
TRIPLE = using the 3.7, 11, and 12 micrometer channels

April 10, 1991
In the SST operation, the maximum limit on the climatological and analyzed field SST value used in the NLSST equation (i.e., Tsfc) is 28 degrees C. The 100 km analyzed field SST from the previous day is used for Tsfc. In the absence of a 100 km analyzed field SST, the daytime split window MCSST equation (as given above) is used to obtain the Tsfc used in the NLSST equation. The threshold for the Channel 4-5 comparison test was changed from 4.0 to 3.5 Kelvin.

May 6, 1991
In the SST operation, increased the density of SST observations to the research density for the region enclosed by 50 to 70N and 10 to 50W.

May 15, 1991
The NOAA-D satellite was launched today from Vandenberg Air Force Base in California.

June 15, 1991
Mount Pinatubo in the Phillipines erupted today sending substantial amounts of aerosols into the stratosphere. These aerosols will have a substantial effect on the SST measurements for the next two years.

June 17, 1991
Began testing NOAA-12 for morning satellite radiation budget in parallel with NOAA-10.

June 28, 1991
Reduced the retention time of data in the Aerosol Extreme Events File form 35 days to 31 days. The Extreme Events File has been repeatedly overflowing.

July 2, 1991
A problem has occurred in the aerosol observation file. The directory of the file and the data are in conflict. The file was restored with a backup from June 29, 1991.

July 9, 1991
Turned off the Relaxed Visible Channel Cloud Test in the NOAA-11 SST operation starting with 12Z data. This action was taken in response to corrupted SST observations in equatorial regions due to stratospheric volcanic dust from the June Mt. Pinatubo eruptions.

July 31, 1991
Changed solar constant for the 3.7 micrometer channel filter to 4.436416 for NOAA-12. Previously, the NOAA-11 value had been used.

August 1, 1991
The Aerosol Extreme Events file was enlarged from 2000 to 2500 records after repeated overflows.

August 13, 1991
The operation program that produces SST and aerosol observations from both NOAA-10 and NOAA-11 was updated today.

August 15, 1991
To obtain additional data to analyze the effects of the Mt. Pinatubo eruption, production of SST observation type 159 (relaxed visible cloud test observations) was resumed (they had been discontinued on July 9, 1991); however, these observations are not accurate and will not be used in the SST analyzed field production. The 159 type observations should not be used for SST products by anyone until further notice.

August 26, 1991
The size of the Aerosol Extreme Events File was increased again from 2500 to 3000 records.

September 16, 1991
NOAA-12 replaced NOAA-10 as the operational morning descending satellite at 2218Z on orbit 1780. The last orbit of NOAA-10 data that was processed operationally was 25961 which

contained data from 2119Z to 2247Z.

October 1, 1991
The first operational NOAA-12 monthly radiation budget archive tape was produced for the month of September.

October 3, 1991
Completed the testing of an equation to correct for the Pinatubo aerosols at night. This "volcano" equation was implemented operationally today. Also increased the SST intercomparison test threshold for nighttime SST to 2.0 degrees. The new equation is (derived from July 1991 buoy matches):

MCSST NIGHT TRIPLE "VOLCANO" EQUATION
SST=1.011015(T12)+2.088810(T3.7-T11)+2.278617(SEC sza-1)-273.234
October 3, 1991
Replaced the CPSST Split-window equation in the aerosol algorithm with the operational NLSST Split-window equation (which was implemented into the SST system on April 10, 1991).

October 18, 1991
Reduced retention period of data in the Aerosol Extreme Events File form 31 to 30 days, in response to overflowing that file.

December 6, 1991
Replace the precipitable water calculation that has been stored in the spare halfword of all SST observations to the NLSST Triple Window Night SST value. This will aid in the study of the impact of the Pinatubo aerosols.

December 18, 1991
A program modification allowed the proper NLSST Triple Window SST value to be placed in the spare halfword of the SST observations. Incorrect values were placed in the spare halfword from December 6, 1991 until today.

December 31, 1991
Solved the problem of missing radiation budget orbits or partial orbits. This problem has been in the system since the radiation budget operation was established.

January 3, 1992
The operational aerosol SST algorithm now uses the dual-window equation:

NLSST NIGHT DUAL
SST = 1.0202(T11) + 0.0512(Tsfc (T3.7-T11)) +2.42(SEC sza-1)-277.5

April 9, 1992
Updated all SST equations. Operational equations are now NLSST Day Split and NLSST Night Dual. The other equations are used in the cloud tests like the SST Intercomparison Test.

NLSST DAY SPLIT
SST=0.962191(T11)+0.083398(Tsfc)(T11-T12)+0.653750(SEC sza-1)(T11-T12)-261.114

MCSST DAY SPLIT
SST=1.02015(T11)+2.320(T11-T12)+0.489(SEC sza-1)(T11-T12)-278.6

NLSST NIGHT DUAL
SST=1.032274(T11)+.055297(Tsfc)(T3.7-T11)+2.125323(SEC sza-1)-280.212

NLSST NIGHT SPLIT
SST=0.95554(T11)+.08435(Tsfc)(T11-T12)+1.1127(T11-T12)(SEC sza-1)-259.3

MCSST "VOLCANO" EQUATION
SST=1.00329(T12)+2.0476(T3.7-T11)+2.47(SEC sza-1)-270.9

July 7, 1992
The coefficients in the MCSST DAY SPLIT and NLSST NIGHT SPLIT equations were modified slightly to:

MCSST DAY SPLIT
SST=1.020151(T11)+2.319730(T11-T12)+0.489092(T11-T12)(SEC sza-1.0)- 278.520

NLSST NIGHT SPLIT
SST=0.955535(T11)+0.084348(Tsfc)(T11-T12)+1.126894(T11-T12)(SEC sza-1)-259.323

August 14, 1992
It was discovered that the climatology values in the 100 km Global Analyzed Field File and the 50 km Regional SST Analyzed Field Files have not been updated since May 1992. The climatology values were updated today and will be updated automatically in the future.

August 21, 1992
The aerosol observation file was destroyed on August 20. The file was reconstructed and data was restored.

September 1, 1992
The radiation budget Available Solar Energy product was found to have an error. It was corrected by changing two subroutines in the RADABS program.

September 8, 1992
New navigation software was implemented in the processing of the AVHRR 1b data. AVHRR latitudes and longitudes are now more accurate. Orbital parameters are now in the 1b header and are updated each orbit. Solar Zenith angle is more accurate now.

September 15, 1992
The density of SST observations calculated in the region 10S to 10N latitude and 100E to 70W longitude (through the dateline) was increased to the highest density.

September 17, 1992
The retention period of data in the SST Matchup Data Base was changed from 35 to 31 days.

September 24, 1992
New navigation software removed because some video data was being lost.
September 29, 1992
SST observations of type 159 (Daytime SSTs that pass the relaxed visible cloud threshold table test) are once again being used in generating the SST Analyzed Field files (100 km, 50 km, and 14 km).

October 23, 1992
New navigation software was reimplemented.

November 9, 1992
A change was made in the SST processing program to trap and correct a calibration problem that has been identified. Stray light from the sun, under certain conditions of solar angles and spacecraft orbital position, has been striking the on-board black-body calibration target. This is adversely affected the calibration of the 3.7 micrometer IR channel (Channel 3). The last good calibration coefficients will be used while stray light illuminates the calibration target. The 11 and 12 micrometer IR channels are not affected because there is very little energy in reflected sunlight at these wavelengths.

December 15, 1992
After one month of parallel testing, the entire SST, radiation budget, and aerosol operational system was moved from the National Weather Service mainframe computers to the new NESDIS Central Environmental Satellite Computer System (CEMSCS) mainframe computers.

January 8, 1993
It was discovered that some nighttime SST observations have been erroneously assigned daytime type codes (i.e., 151) since the new navigation software was implemented in October. A filter was put in to trap and discard these observations.

May 5, 1993
The time period for selection of observations to be transmitted over the World Meteorological Organization (WMO) Global Telecommunications System (GTS) has been changed from 24 to 15 hours. All observations during the previous 15 hours in a 2.5 degree latitude by 2.5 degree longitude box are averaged before transmission. Previously, the nearest observation to the center of the box was transmitted (i.e., no averaging).

May 25, 1993
A routine was added to the SST processing system to remove duplicate observations from the SST 8-day observation file. In the past some duplicate observations were possible when orbits would be reingested and reprocessed.

June 11, 1993

New SST equations were implemented for NOAA-11 SST to correct biases now that the Pinatubo aerosols have dissipated. The MCSST split-window equation was erroneously used as the daytime operational equation. The nighttime operational equation is the NLSST triple window equation. The equations are:
NLSST DAY SPLIT
SST=0.92323(T11)+0.082523(Tsfc)(T11-T12)+0.463038(SEC sza-1)(T11-T12)-250.109

MCSST DAY SPLIT
SST=0.979224(T11)+2.361743(T11-T12)+0.33084(SEC sza-1)(T11-T12)-267.029

NLSST NIGHT TRIPLE
SST=0.970625(T11)+0.035216(Tsfc)(T3.7-T12)+1.522429(SEC sza-1)-263.231

NLSST NIGHT DUAL
SST=1.01876(T11)+.053929(Tsfc)(T3.7-T11)+1.830512(SEC sza-1)-276.439

NLSST NIGHT SPLIT
SST=0.899907(T11)+.091549(Tsfc)(T11-T12)+0.647912(T11-T12)(SEC sza-1)-243.821

MCSST NIGHT SPLIT
SST=0.978971(T11)+2.593454(T11-T12)+0.623203(T11-T12)(SEC sza-1)-267.542

June 14, 1993
Corrected daytime operational SST equation to the NLSST SPLIT WINDOW shown under the June 11 entry above.

August 9, 1993
NOAA-I was launched at 10Z aboard an Atlas E launch vehicle from Vandenberg Air Force Base.

August 21, 1993
Contact with NOAA-I (i.e., NOAA-13) was lost at about 18Z. A short -circuit caused by a screw that was too long was the probable cause of failure.

October 7, 1993
Changed the radiation budget coefficients ACOF, BCOF, CCOF for NOAA-12. Previously these had been old NOAA-10 coefficients. They have now been changed to current NOAA-11 coefficients (see the July 2, 1990 entry for the coefficients).

October 11, 1993
Began outgassing of NOAA-12 in order to reduce the noise in the 3.7 micrometer channel of the AVHRR. Radiation budget products will not be available during the outage.

October 20, 1993
Completed the outgassing of NOAA-12.

December 1, 1993
Modifications were made to the calibration software in the AVHRR 1b processing to correct for the effects of scattered sunlight in the 3.7 micrometer channel. This is the same correction that was implemented in the SST processing program on November 9, 1992. Now the benefits of this correction have been made available to all AVHRR 1b users.

December 20, 1993
Turned on the high-resolution land/sea tags in the NOAA-11 nighttime SST algorithm in order to increase the number of retrievals in the Great Lakes. Previously, only the daytime algorithm used the high-resolution land/sea tags in coastal regions. Use of high-resolution land/sea tags allows SST observations to be made as close as 5 km to a land boundary. Without the high-resolution tags, observations cannot be made any closer than 25 km to land.

May 4, 1994
A VS FORTRAN version of the SST field analysis program FLDGEN was implemented for the 100, 50, and 14 km SST fields.

September 1, 1994
Changed the radiation budget operation to the NOAA-K,L,M retrieval system (i.e., RADRET).

September 7, 1994
Navigation change to HIRS processing. Navigation parameters are updated orbit by orbit rather than once per day.

September 14, 1994
At approximately 00Z, NOAA-11 experienced an apparent electrical problem with the AVHRR instrument. Other NOAA-11 instruments are now affected. No NOAA-11 SST observations, radiation budget observations or aerosol observations were made after this failure.

September 15, 1994
Began using NOAA-12 operationally for SST observation production.
The operational SST equations are the NLSST DAY SPLIT for daytime data and the NLSST NIGHT TRIPLE for nighttime data (the other equations given are used in various cloud tests). The equations being used were first derived on 3/8/94. The equations for NOAA-12 are:

NLSST DAY SPLIT
SST=0.876992(T11)+0.083132(Tsfc)(T11-T12)+0.349877(SEC sza-1)(T11-T12)-236.667

MCSST DAY SPLIT
SST=0.963563(T11)+2.579211(T11-T12)+0.242598(SEC sza-1)(T11-T12)-263.006

NLSST NIGHT TRIPLE
SST=0.963368(T11)+0.033139(Tsfc)(T3.7-T12)+ 1.731971(SEC sza-1)-260.854
NLSST NIGHT DUAL
SST=1.021468(T11)+.050549(Tsfc)(T3.7-T11)+2.201377(SEC sza-1)-276.9

NLSST NIGHT SPLIT
SST=0.888706(T11)+.081646(Tsfc)(T11-T12)+ 0.576136(T11-T12)(SEC sza-1)-240.229

MCSST NIGHT SPLIT
SST=0.967077(T11)+2.384376(T11-T12)+0.480788(T11-T12)(SEC sza-1)-263.94

The following equations are not used in the SST operation, but are provided here for reference:

MCSST NIGHT TRIPLE
SST=1.000281(T11)+0.911173(T3.7-T12)+1.710028(SEC sza-1)-271.971

MCSST NIGHT DUAL
SST=1.031355(T11)+1.288548(T3.7-T11)+2.265075(SEC sza-1)-279.846

September 20, 1994
Changed ACOF, BCOF and CCOF in the NOAA-12 RADRET radiation budget coefficient database to what they should have been on September 1. They now correspond to what was being used for NOAA-12 in the old radiation budget system. The values are:

	ACOF	BCOF	CCOF
OLD	4.092	1.1904	-0.001025
NEW	-10.14	1.2681	-0.001117

CCOF, however, was not changed until October 3, 1994. It remained -0.001012 until then.

September 21, 1994
Changed the ACONST and BCONST parameters in the RADRET coefficient data base. The values are:

	ACONST	BCONST
OLD	8961.325	1308.647
NEW	6988.885	1204.577

where ACONST=1.1910659 X 10^{-5} (v^3) and BCONST=1.438833 (v), where v = central wave number for the 12 micrometer channel (837.19 was used for the central wave number).

October 3, 1994
Changed CCOF in the radiation budget system to -0.001117. Also in the radiation budget system, changed the 11 and 12 micrometer channel central wave numbers and the 3.7 micrometer channel filter solar constant to the NOAA-12 values. These values have been the NOAA-10 values. This appears at the first look to have brought NOAA-12 radiation budget values down by approximately 20 W/m^2, as hoped.

November 1, 1994

Changed the input parameters to the WMO satellite observation generation program to the NOAA-12 satellite ID so that NOAA-12 observations go out to WMO users. This product has been off-line since the NOAA-11 AVHRR failed on September 13, 1994.

November 15, 1994
The navigation system for the AVHRR 1b processing was updated to include clock corrections (but this was not activated at this time). Navigation parameters in the header are now scaled integers (easier to read).

December 30, 1994
NOAA-J was launched at 10:02Z aboard an Atlas-E launch vehicle, from Vandenberg Air Force Base, California.

March 20, 1995
Began using NOAA-14 for operational processing of SST.
MCSST=linear multi-channel Sea Surface Temperature algorithm.
NLSST=Non-linear Sea Surface Temperature algorithm (SST). All equations based on March 1995 global drifting buoy and tropical Pacific fixed buoy matchups. T3.7, T11 and T12 =AVHRR channels 3, 4 and 5 brightness temperatures (K). SEC0=secant of Satellite zenith angle. Tsfc is an a priori estimate of surface temperature (degree C). Preferably, it should be based on satellite only or blended or climatological based field analysis but may be derived from the actual satellite measurements using one of the MCSST equations. In operational use, Tsfc is limited to the range between 28 and -2 degrees C. The new day and night operational equations are denoted by asterix.

Example of use:
Night NLSST Split SST = 0.0781 x Tsfc x (T11-T12) + 0.9331 x T11
+0.7381*(T11-T12) x (SEC0-1) -253.43 (degrees C).

Regression Output: Night NLSST Split			
Constant		-253.428	
Std Err of Y Est		0.480436	
R Squared		0.993766	
No. of Observations		1055	
Degrees of Freedom		1051	
	Tsfc x (T11-T12)	T11	(T11-T12) x (SEC0-1)
X Coefficient(s)	0.078095	0.933109	0.738128
Std Err of Coef.	0.001017	0.004392	0.03915

Regression Output: Night MCSST Split	
Constant	-282.24
Std Err of Y Est	0.535959
R Squared	0.992242
No. of Observations	1055
Degrees of Freedom	1051

	(T11-T12)	T11	(T11-T12) x (SEC0-1)
X Coefficient(s)	2.275385	1.029088	0.752567
Std Err of Coef.	0.033812	0.004022	0.043759

Regression Output: ***Night NLSST Triple***			
Constant		-266.186	
Std Err of Y Est		0.427116	
R Squared		0.995073	
No. of Observations		1055	
Degrees of Freedom		1051	
	Tsfc x (T3.7-T12)	T11	SEC0-1
X Coefficient(s)	0.031889	0.980064	1.817861
Std Err of Coef.	0.000316	0.003461	0.069577

Regression Output: Night MCSST Triple			
Constant		-275.364	
Std Err of Y Est		0.41102	
R Squared		0.995438	
No. of Observations		1055	
Degrees of Freedom		1051	
	(T3.7-T12)	T11	SEC0-1
X Coefficient(s)	0.920822	1.010037	1.730411
Std Err of Coef.	0.008757	0.003153	0.067026

Regression Output: Night NLSST Dual			
Constant		-276.813	
Std Err of Y Est		0.461235	
R Squared		0.994255	
No. of Observations		1055	
Degrees of Freedom		1051	
	Tsfc x (T3.7-T11)	T11	SEC0-1
X Coefficient(s)	0.050086	1.019182	2.039266
Std Err of Coef.	0.000541	0.003496	0.074861

Regression Output: Night MCSST Dual			
Constant		-273.914	
Std Err of Y Est		0.432718	
R Squared		0.994943	
No. of Observations		1055	
Degrees of Freedom		1051	
	(T3.7-T11)	T11	SEC0-1
X Coefficient(s)	1.409936	1.008751	1.975581
Std Err of Coef.	0.01419	0.003332	0.070296

Regression Output: *** Day NLSST Split ***			
Constant		-255.165	
Std Err of Y Est		0.507031	
R Squared		0.994647	
No. of Observations		865	
Degrees of Freedom		861	
	Tsfc x (T11-T12)	T11	(T11-T12) x SEC0-1
X Coefficient(s)	0.076066	0.939813	0.801458
Std Err of Coef.	0.00148	0.004885	0.048744

Regression Output: Day MCSST Split			
Constant		-278.43	
Std Err of Y Est		0.570485	
R Squared		0.993223	
No. of Observations		865	
Degrees of Freedom		861	
	(T11-T12)	T11	(T11-T12) x SEC0-1
X Coefficient(s)	2.139588	1.017342	0.779706
Std Err of Coef.	0.049017	0.004365	0.055699

March 28, 1996
The orbit vectors received from the U.S. Navy contained an apparent 1 second error for all satellites. The error was not detected and corrected for NOAA-12 until after the following passes were processed. All other satellites were not updated with the erroneous orbit data. The navigation QC for NOAA-12 indicated an average error of 7.0 kilometers at nadir. A list of all passes affected is provided below. The one second error has been removed from the Navy vectors, however the quality of the orbital data is still somewhat degraded. Navy personnel are investigating. Until this problem is resolved, Air Force vectors will be used instead of the Navy vectors whenever possible.

NSS.GHRR.ND.D96088.S0109.E0257.B2529394.GC
NSS.GHRR.ND.D96088.S0615.E0809.B2529697.WI
NSS.GHRR.ND.D96088.S0804.E0958.B2529798.WI
NSS.GHRR.ND.D96088.S0953.E1144.B2529899.WI
NSS.GHRR.ND.D96088.S1140.E1325.B2529900.WI
NSS.GHRR.ND.D96088.S1320.E1500.B2530001.GC

NSS.HRPT.ND.D96088.S0259.E0310.B2529494.GC
NSS.HRPT.ND.D96088.S1327.E1336.B2530000.WI
NSS.HRPT.ND.D96088.S1504.E1509.B2530101.GC

NSS.LHRR.ND.D96088.S0206.E0213.B2529393.GC
NSS.LHRR.ND.D96088.S0210.E0221.B2529393.GC
NSS.LHRR.ND.D96088.S0505.E0513.B2529595.WI

NSS.LHRR.ND.D96088.S0635.E0646.B2529696.WI
NSS.LHRR.ND.D96088.S0755.E0804.B2529797.WI
NSS.LHRR.ND.D96088.S0814.E0825.B2529797.WI
NSS.LHRR.ND.D96088.S0855.E0906.B2529797.WI
NSS.LHRR.ND.D96088.S1220.E1231.B2529999.WI
NSS.LHRR.ND.D96088.S1312.E1323.B2530000.WI
NSS.LHRR.ND.D96088.S1320.E1331.B2530000.GC

April 18, 2000
On Friday April 14, 2000, it was discovered that NOAA-11 HIRS instrument was experiencing a filter wheel motor anomaly. This caused an interruption in the HIRS Level 1b data. Since that time the instrument team and SOCC have been trying to correct the problem. Today the NOAA-11 HIRS filter wheel motor was set to high mode, and the filter housing heater was turned on. These commands were nominal. Other spacecraft telemetry remain nominal, as the instrument team continues to analyze the HIRS filter wheel anomaly.

After numerous commands and attempts to restore the instrument to an operational state have failed, the outlook for resuming operations is not very promising. The instrument team along with members of NASA , and NESDIS operations personnel are currently evaluating the situation and a decision to shut-off the instrument or not is pending.

This situation has caused the NOAA-11 Level 1b data to be unavailable, and future availability is very bleak.

26 May 2000Beginning sometime after May 19th, we noticed that the earth location error seen in the NOAA-14 AVHRR data is consistently about 1 to 2 kilometers. The current clock drift error reported in the TBUS bulletin and on the Navigation home page (http://www.osdpd.noaa.gov/PSB/PPP/NAVIGATION/navpage.html) has not changed and if used with the current data will increase the error. We are observing the Level 1b data to determine if this is a consistent change and to get some idea of why it has occurred. Data for the other NOAA satellites have not changed. If our continued investigation next week indicates that the clock drift data should be updated, the Navigation website will be updated.

June 1, 2000
The clock drift reported for NOAA-14 still does not fit the data. It appears to also have a +500 millisecond error that is negating the clock error.

June 20, 2000
In an effort to improve the ability to update and manage clock adjustments, SOCC has updated the flight software on NOAA-14 and will be conducting a test of their clock adjustment capability around 12:00 local today. The test is planned to begin on orbit 28209 from Gilmore around 1553Z. During this test time period, clock adjustments will be made every 45 seconds in the following sequence.
+ 100 milliseconds (ms)
- 100 ms
+900 ms

- 900 ms
+ 750 ms
- 750 ms
+ 250 ms
- 250 ms
At the end of the test, data should have returned to the pre-test condition.

July 27, 2000
For NOAA -12 and -14, we are preparing our parallel operations to provide test data with clock corrections turned on. These test files will also contain the corrected scan angle in the AVHRR (we changed the maximum angle from ∀55.40 to ∀55.37). Our tests have shown that as much as a 2 kilometer improvement will be seen in the earth locations from the scan angle adjustment alone. The clock corrections will improve the data such that the remaining error is approaching 1 kilometer or less.

We look forward to beginning the parallel tests for NOAA-12 and -14 next week and turning on the corrections within two weeks of that date. The actual implementation data will be announced next week.

August 15, 2000
On August 29, 2000, we plan to turn on clock corrections for all instrument level 1B data processed for the NOAA-12 and 14 satellites. Turning on clock corrections should not require a change by the user community. However, you should see an improvement in the earth location data of approximately 6 kilometers for NOAA-D/12 and approximately a 2 kilometer improvement for NOAA-14 (both along track).

We also plan to implement the latest AELDS (Advanced Earth Location Data System) in the NOAA-A-J SBUV processing. This change will alter the solar azimuth angle computed so that sign of the value is switched (the magnitude remains the same).

29 Aug 2000
The updates to the NOAA A-J series processor became operational as indicated below. This update included: turning on the clock drift updates, changing AVHRR max scan angle to ∀55.37 rather than ∀55.40, and integration of updated earth location (AELDS) into SBUV processing.

Please note that in the future the clock drift corrections will be turned on/off or adjusted as dictated by the accuracy of the data and the adjustments applied by SOCC. The user will be notified as soon as possible after the fact when problems occur. Please remember to check the appropriate bits to know when corrections are being applied and the magnitude of the corrections. There are scheduled clock updates for both NOAA-12 and -14 today at 235900Z. The Level 1b data should automatically reflect the adjustments so that the accuracy of the earth location data is maintained. No action is required on the part of the Level 1b user. The planned updates are (as reported by SOCC):

NOAA-12's Elapsed Time Clock (ETC) is drifting negative at about 4 milliseconds per day, and is now reading -1100 milliseconds. It is necessary to add 1.0 second to ETC to bring it within the limit. This update is scheduled for August 29, 2000 via SCT at 23:59:00Z.

NOAA-14's ETC is drifting positive at about 8 milliseconds per day, and is now reading +400 milliseconds. It is necessary to subtract 1.0 seconds from ETC to bring it within the limit. This update is scheduled for August 29, 2000 via SCT at 23:59:00Z.

Last passes processed before change:
NSS.GHRR.ND.D00242.S0805.E0956.B4826465.WI
NSS.LHRR.ND.D00242.S1125.E1130.B4826666.WI
NSS.HRPT.ND.D00242.S1320.E1333.B4826767.MO
NSS.HRPT.NJ.D00242.S1227.E1241.B2919595.MO
NSS.LHRR.NJ.D00242.S1159.E1207.B2919595.GC
NSS.GHRR.NJ.D00242.S1038.E1219.B2919495.GC

Passes that may be lost, may be received late and processed after change:
NSS.GHRR.ND.D00242.D0951.E1137.B4826566.WI

First passes processed after change:
NOAA-14
NSS.HRPT.NJ.D00242.S1402.E1414.B2919696.GC
NSS.HRPT.NJ.D00242.S1409.E1419.B2919696.MO
NSS.GHRR.NJ.D00242.S1214.E1400.B2919596.GC
NSS.LHRR.NJ.D00242.S1344.E1356.B2919696.GC
NSS.LHRR.NJ.D00242.S1333.E1345.B2919596.GC

NOAA-12
NSS.HRPT.ND.D00242.S1454.E1505.B4826868.GC
NSS.LHRR.ND.D00242.S1209.E1219.B4826666.GC
NSS.LHRR.ND.D00242.S1306.E1311.B4826767.GC
NSS.TIPX.ND.D00242.S1131.E1325.B4826667.GC

SBUV NOAA-11
NSS.TIPS.NH.D00242.S1147.E1342.B6151718.WI

November 30, 2000NOAA A-J Level 1b preprocessing systems will be updated to allow scan geometry parameters to be changed to user supplied parameters. This will give us the ability to adjust the scan geometry differently for different satellites. User impact - improved earth location data due to use of double precision variables. New MSU scan angle ∀∀47.3685 degrees (difference in latitude of 0.01 degrees, longitude 0.03 degrees); AVHRR new stepping angle 0.05407226563 degrees for all satellites.

December 13, 2000The preprocessor release 2.7 will be implemented into operations on December 14, 2000 between the hours 11:05 am and 12:15 pm local time. The following will be put into operations:

New earth location software changes for all instruments which will support NOAA-12 and -14.The first pass after the update will be:NSS.GHRR.ND.D00249.S1420.E1544.B4979091.GCNSS.HRPT.NJ.D00349.S1633.E1647.B3070808.GC

January 2, 2001
NOAA-12 and -14 Clock Corrections were discontinued after we discovered that the scan line time codes were being changed incorrectly for all AVHRR Level 1b data. The problem affected all AVHRR data for day 1 and 2 ending with the following passes:
NSS.GHRR.NJ.D01002.S1255.E1427.B3097475.GC
NSS.HRPT.NJ.D01002.S1428.E1441.B3097575.GC
NSS.LHRR.NJ.D01002.S1411.E1422.B3097575.GC

NSS.HRPT.ND.D01002.S1508.E1520.B5006161.GC
NSS.LHRR.ND.D01002.S1139.E1144.B5005959.GC

Clock corrections will be resumed as soon as a correction for the problem can be made.

The Computer Operations Branch has recreated the Level 1b files for those passes that still had Level 1A data available on the CEMSCS. They will be automatically sent out as normal. All instrument data was reprocessed and the following datasets were reprocessed successfully:
NOAA-14
NSS.GHRR.NJ.D01002.S0357.E0552.B3096970.WI.A
NSS.GHRR.NJ.D01002.S0546.E0741.B3097071.WI.A
NSS.GHRR.NJ.D01002.S0736.E0929.B3097172.WI.A
NSS.GHRR.NJ.D01002.S0924.E1110.B3097273.WI.A
NSS.GHRR.NJ.D01002.S1106.E1259.B3097374.GC.A
NSS.GHRR.NJ.D01002.S1255.E1427.B3097475.GC.A
NSS.HRPT.NJ.D01002.S1249.E1257.B3097474.GC.A
NSS.HRPT.NJ.D01002.S1253.E1307.B3097474.MO.A
NSS.HRPT.NJ.D01002.S1428.E1441.B3097575.GC.A
NSS.LHRR.NJ.D01001.S2102.E2108.B3096565.GC.A
NSS.LHRR.NJ.D01001.S2247.E2251.B3096666.GC.A
NSS.LHRR.NJ.D01002.S0427.E0433.B3096969.WI.A
NSS.LHRR.NJ.D01002.S0904.E0915.B3097272.WI.A
NSS.LHRR.NJ.D01002.S1051.E1103.B3097373.WI.A
NSS.LHRR.NJ.D01002.S1411.E1422.B3097575.GC.A
NSS.TIPH.NJ.D01002.S1249.E1257.B3097474.GC.A
NSS.TIPH.NJ.D01002.S1253.E1308.B3097474.MO.A
NSS.TIPH.NJ.D01002.S1428.E1441.B3097575.GC.A
NSS.TIPX.NJ.D01002.S0357.E0552.B3096970.WI.A
NSS.TIPX.NJ.D01002.S0546.E0741.B3097071.WI.A
NSS.TIPX.NJ.D01002.S0736.E0929.B3097172.WI.A
NSS.TIPX.NJ.D01002.S0924.E1110.B3097273.WI.A
NSS.TIPX.NJ.D01002.S1106.E1259.B3097374.GC.A
NSS.TIPX.NJ.D01002.S1255.E1427.B3097475.GC.A

NOAA-12
NSS.HRPT.ND.D01002.S1329.E1338.B5006060.GC.A
NSS.HRPT.ND.D01002.S1334.E1348.B5006060.MO.A
NSS.HRPT.ND.D01002.S1334.E1348.B5006060.MO.A
NSS.LHRR.ND.D01001.S2057.E2105.B5005050.WI.A
NSS.LHRR.ND.D01001.S2114.E2120.B5005050.WI.A
NSS.LHRR.ND.D01002.S0140.E0145.B5005353.GC.A
NSS.LHRR.ND.D01002.S0239.E0247.B5005353.GC.A
NSS.LHRR.ND.D01002.S0958.E1003.B5005858.WI.A
NSS.LHRR.ND.D01002.S1139.E1144.B5005959.GC.A
NSS.TIPH.ND.D01002.S1329.E1338.B5006060.GC.A
NSS.TIPH.ND.D01002.S1334.E1348.B5006060.MO.A
NSS.TIPH.ND.D01002.S1508.E1520.B5006161.GC.A
NSS.TIPX.ND.D01002.S0448.E0643.B5005556.WI.A
NSS.TIPX.ND.D01002.S0638.E0832.B5005657.WI.A
NSS.TIPX.ND.D01002.S0827.E1011.B5005758.WI.A
NSS.TIPX.ND.D01002.S1005.E1200.B5005859.GC.A
NSS.TIPX.ND.D01002.S1156.E1326.B5005960.GC.A
NSS.TIPX.ND.D01002.S1322.E1507.B5006061.GC.A

January 19, 2001
On January 24,2001, clock drift corrections will be turned on for NOAA-12 and NOAA-14.

January 24, 2001
Clock corrections for NOAA-12 and -14 were resumed today. It is easier to identify those orbits processed today that do not have clock error corrections included. The following orbits were the last passes processed before clock corrections went into effect.

For NOAA-14 GHRR (also for TIPX):
NSS.GHRR.NJ.D01024.S0122.E0301.B3127879.GC
NSS.GHRR.NJ.D01024.S0255.E0450.B3127980.WI
NSS.GHRR.NJ.D01024.S0444.E0639.B3128081.WI
NSS.GHRR.NJ.D01024.S0634.E0828.B3128182.WI
NSS.GHRR.NJ.D01024.S1014.E1207.B3128384.GC
NSS.GHRR.NJ.D01024.S1203.E1327.B3128485.GC

The last passes processed before clock corrections were turned on for HRPT were:
NSS.HRPT.NJ.D01024.S1329.E1341.B3128585.GC
NSS.HRPT.ND.D01024.S1328.E1341.B5037373.MO

The last pass processed before clock corrections were turned on for NOAA-12 TIPX was:
NSS.TIPX.ND.D01024.S0829.E1004.B5037071.WI

The only passes processed for day 024 with no clock corrections for LHRR were:
NSS.LHRR.NJ.D01024.S0146.E0152.B3127878.GC

NSS.LHRR.NJ.D01024.S0441.E0449.B3128080.WI
NSS.LHRR.ND.D01024.S0030.E0036.B5036565.GC

February 21, 2001
Beginning with the following passes, the Level 1b pre-processor for NOAA-12 and -14 was updated. This should have been a no impact change to the earth location portion of the software.

NOAA-12
NSS.GHRR.ND.D01052.S1729.E1925.B5077475.WI

NOAA-14
NSS.GHRR.NJ.D01052.S1755.E1950.B3168384.WI

E.2 CHANGES MADE TO NAVY SST OBSERVATION PRODUCT

March 30, 1995
Began using NOAA-14 for operational processing of SST=s. All equations based on February and March 1995 global drifting buoy match ups. The operational SST equations are the NLSST DAY SPLIT for daytime data and the NLSST NIGHT TRIPLE for nighttime data.

NLSST DAY SPLIT
NL(4/5) = .9355T4 + .0780Tf (T4-T5) + .8009 (T4-T5)(SEC(A) -1) - 254.0163

NLSST NIGHT TRIPLE
NL(3/4/5) = .9796T4 + .032Tf (T3-T5) + 1.8106 (SEC (A) -1) - 266.1146

T3 = Channel 3 Brightness Temperature (K)
T4 = Channel 4 Brightness Temperature (K)
T5 = Channel 5 Brightness Temperature (K)
Tf = Analyzed Field Temperature (C)
A = Satellite Zenith Angle

April 11, 1995
Began operationally storing satellite retrievals up to 80N latitude within the TOGA and daily 100 km field file as well as matching satellite retrievals and buoy measurements within the satellite match up database.

May 18, 1995
Operationally implemented HIRS two part cloud screening test for relaxed daytime processing, replacing current relaxed visible cloud threshold test. This change was necessary due to the occurrence of high Channel 2 reflectance in sun glitter ocean areas. In order to produce retrievals in sun glitter ocean areas the daytime gross Channel 2 cloud test was relaxed from 10 to 50 percent reflectance.

June 7, 1995

The moored TOGA-TAO array buoys have been placed into the SST Match up data base. This data source is now used for statistical accuracy comparisons in addition to the present drifting buoy data.

June 14, 1995
Limited relaxed daytime processing to latitude bands where sun glitter is frequent (60N-60S), also reduced gross Channel 2 threshold from 50 to 15 percent since most relaxed daytime retrievals obtained in sun glitter regions were less than 15 percent reflectance. These modifications were implemented to eliminate the generation of relaxed daytime retrievals over ice.

June 16, 1995
Modified threshold for the 100 km field portion of the HIRS two part cloud screening test for relaxed daytime processing from 3.0 to 2.5 to be more restrictive.

June 22, 1995
Improved and expanded coverage of NOAA-14 visible cloud threshold table, with the addition of 200+ orbits of reflectance data collected during the month of May.

October 23, 1995
NOAA-14 Channel 2 calibration was corrected by NOAA/NESDIS operations on July 31. A new visible cloud threshold table was generated using 250+ orbits of Channel 2 reflectance data obtained during the August time frame and operationally implemented.

October 24, 1995
Modified relaxed daytime cloud screening, the HIRS two part test is only utilized between 40N-40S with high latitude regions using the previous retrieval method of relaxing the visible cloud threshold table by a relaxation factor of approximately 1.5.

November 20, 1995
The latitudinal band for the relaxed daytime HIRS two part test was modified to be between 40N-50S to allow for seasonal shift in the sun glitter pattern.

December 7, 1995
Operationally implemented new coefficients for the HIRS portion of the HIRS two part test for NOAA-14.

May 30, 1996
The latitudinal band for the relaxed daytime HIRS two part test was modified to be between 50N-50S, due to the withdrawal of the ice edge in the northern hemisphere.

November 4, 1996
After a successful completion of OPTEST, operational processing of satellite SST retrievals was moved from Concurrent mainframes to SGI challenge workstations.

November 25, 1996

The latitudinal band for the relaxed daytime HIRS two part test was modified to be between 40N-50S to account for the southward drift of the northern hemisphere ice edge.

January 29, 1997
Modified Channel 2 nighttime reflectance test. Increased Channel 2 reflectance threshold for twilight regions (solar zenith angles between 75 - 90) from 1.0 to 1.7, leaving the threshold at 1.0 for solar zenith angles greater than 90.

February 20, 1997
Modified Channel 2 nighttime reflectance test. Increased Channel 2 reflectance threshold for twilight regions from 1.7 to 1.8. Modified Channels 4-5 threshold for nighttime processing from 4.0 to 3.5.

March 20, 1997
Modified daytime gross Channel 2 cloud test from 15 to 18 percent reflectance. This change was implemented to fill data voids occurring in high sun glint regions in the Indian Ocean and Tropical Pacific.

April 17, 1997
Operationally implemented new visible cloud threshold table (obtained from NOAA/NESDIS) consisting of data collected during the November 1996 - February 1997 time frame.

April 21, 1997
Expanded K100 land/sea tags in coastal areas. NLSSTs are now being calculated with 100 km field values as the T_f term rather than MCSST estimates, which have proven to be occasionally cloud contaminated. The Two Part HIRS/FLD test and climatology test are now fully functional in these areas since the 100 km field has a valid SST value and climatology value along the coastal regions.

May 19,1997
The latitudinal band for the relaxed daytime Two Part HIRS/FLD test was modified to be between 50N - 50S, due to withdrawal of the ice edge in the Northern Hemisphere.

August 6, 1997
Operationally implemented lower limit check (if Tf term is less than 0.1, set Tf term to 0.1) for 100 km field value used in NLSST calculations.

November 26, 1997
Operationally implemented a hybrid climatology file. This climatology file contains data from NCEP adjusted Optimum Interpolation (OI) climatology from 70 S to 70 N and data from NCAR 20 year climatology from 70 N to 80 N.

December 8, 1997
Modified operational 100 km file, initiating field and climatological values in the Great Lakes.

December 8, 1997

The latitudinal band for the relaxed daytime HIRS two part test was modified to be between 40 N - 50 S to account for the southward drift of the Northern Hemisphere ice edge.

January 7, 1998
Modified cloud screening techniques in areas of high specular reflectance, relaxed daytime processing will use the HIRS two part test only in high specular reflectance areas and the relaxed visible cloud threshold test for all other portions of the scan. This results in a reduction of aerosol contaminated retrievals.

March 31, 1998
The PIRATA (Pilot Research Moored Array in the Tropical Atlantic) array buoys have been placed into the MCSST Matchup Database. This data source is now used for operational MCSST statistical accuracy comparisons.

May 11, 1998
Began updating K100 climatology values on a daily basis versus monthly updates.

July 6, 1998
Operationally incorporated AOD (Aerosol Optical Depth) values into orbital MCSST product.

October 5, 1998
Implemented new VCLD (Visible Cloud Threshold Table), modifying table default values from 1.6% reflectance to 1.8%.

November 23, 1998
Modified daytime target high-density search pattern resulting in improved data distribution.

December 9, 1998
Implemented new VCLD table (obtained from NOAA/NESDIS), this table was generated to compensate for low daytime observations caused by new scan angle geometry.

March 31, 1999
NOAA-14: After a successful completion of OPTEST, operational processing of MCSST's was moved from SGI Challenge workstations to SGI Origin 2000 workstations.

April 12, 1999
NOAA-14: Modified processing code to use calculated solar zenith angle for cloud screening tests versus nearest angle extracted from input data set.

April 12, 1999
NOAA-14: Modified type 159 processing, HIRS/2 part test is run in all areas outside of specular reflectance regions in addition to relaxed visible cloud test. Specular reflectance regions do not run the relaxed visible cloud test.

May 18, 1999
Updated NOAA-14 equations based on March 1999 global drifting buoy match ups. The

operational MCSST equations are the NLSST DAY SPLIT and the NLSST NIGHT TRIPLE.

NLSST DAY SPLIT
NL(4/5) = .9309T4 + .0768Tf (T4-T5) + .6612 (T4-T5)(SEC(A) -1) - 252.5215
NLSST NIGHT TRIPLE
NL(3/4/5) = .9807T4 + .032Tf (T3-T5) + 1.7326 (SEC (A) -1) - 266.3910

T3 = Channel 3 Brightness Temperature (K)
T4 = Channel 4 Brightness Temperature (K)
T5 = Channel 5 Brightness Temperature (K)
Tf = Analyzed Field Temperature (C)
A = Satellite Zenith Angle

August 17, 2000
NOAA-14: Modified nighttime cloud screening, replaced low stratus AVHRR 5-3 test with AVHRR 4-3 test.

August 28, 2000
NOAA-14: Implemented new Visible Cloud Threshold table, generated with data collected during the July-Aug, 2000 time frame.

October 10, 2000
NOAA-14: Updated NOAA-14 equations based on August 2000 global drifting buoy matches. The operational MCSST equations are the NLSST DAY SPLIT and the NLSST NIGHT TRIPLE.

NLSST DAY SPLIT
NL(4/5) = .9522T4 + .0755Tf (T4-T5) + .6723 (T4-T5)(SEC(A) B1) B 258.5574

NLSST NIGHT TRIPLE
NL(3/4/5) = .9810T4 + .0321Tf (T3-T5) + 1.8030 (SEC(A) B1) B 266.3967

T3 = Channel 3 Brightness Temperature (K)
T4 = Channel 4 Brightness Temperature (K)
T5 = Channel 5 Brightness Temperature (K)
Tf = Analyzed Field Temperature (C)
A = Satellite Zenith Angle

February 27, 2001
NOAA-14: Updated NOAA-14 nighttime equations based on January 2001 global drifting buoy matches. The operational MCSST nighttime equation is the NLSST NIGHT TRIPLE.

NLSST NIGHT TRIPLE
NL(3/4/5) = .9774T4 + .0334Tf (T3-T5) + 1.4792 (SEC(A) B1) B 264.9391

T3 = Channel 3 Brightness Temperature (K)
T4 = Channel 4 Brightness Temperature (K)
T5 = Channel 5 Brightness Temperature (K)
Tf = Analyzed Field Temperature (C)
A = Satellite Zenith Angle

March 7, 2001
Operationally implemented new orbital MCSST processing software (SEATEMP). The new software contains improved cloud screening, which enables more retrieval attempts per target for both day and night processing.

NOAA-14: Implemented Orbital MCSST equations derived for NOAA-14 SEATEMP processing. Equations based on January 2001 global drifting buoy matches. The operational MCSST equations are the NLSST DAY SPLIT and the NLSST NIGHT TRIPLE.

NLSST DAY SPLIT
NL(4/5) = .9506T4 + .0760Tf (T4-T5) + .6839 (T4-T5)(SEC(A) B1) B 258.0968

NLSST NIGHT TRIPLE
NL(3/4/5) = .9843T4 + .0332Tf (T3-T5) + 1.4158 (SEC(A) B1) B 266.8967

T3 = Channel 3 Brightness Temperature (K)
T4 = Channel 4 Brightness Temperature (K)
T5 = Channel 5 Brightness Temperature (K)
Tf = Analyzed Field Temperature (C)
A = Satellite Zenith Angle

May 21, 2001
NOAA-14: Updated NOAA-14 nighttime equations based on April 2001 global drifting buoy matches. The operational MCSST nighttime equation is the NLSST NIGHT SPLIT.

NLSST NIGHT SPLIT
NL(4/5) = .9242T4 + .0755Tf (T4-T5) + .6040 (T4-T5)(SEC(A) B1) B 250.4284
T4 = Channel 4 Brightness Temperature (K)
T5 = Channel 5 Brightness Temperature (K)
Tf = Analyzed Field Temperature (C)
A = Satellite Zenith Angle

June 28, 2001
NOAA-14: Implemented a field test for type 159 processing in areas of high specular reflectance. This test will help eliminate the generation of aerosol contaminated observations.

September 18, 2001
NOAA-14: Implemented a two-part nighttime aerosol test. The test has to fail both an SST intercomparison (MC(3/4) equation minus NL (4/5) equation) and a field test to be rejected as

aerosol contaminated.
October 9, 2001
NOAA-14: Implemented reliability values that are assigned to each MCSST observation.