National Aeronautics and Space Administration
Goddard Earth Science
Data Information and Services Center (GES DISC)

README Document for the TIROS Low-Resolution Omnidirectional Radiometer Level 1 Temperature Data

TIROS3L1ORT
TIROS4L1ORT

Last Revised 10/22/2021

Goddard Earth Sciences Data and Information Services Center (GES DISC)
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Revision History

Revision Date	*Changes*	*Author*
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1. Introduction

This document provides basic information on using the Low-Resolution Omnidirectional Radiometer Level 1 Omnidirectional Radiometer Temperature (or ORT) data products from TIROS-3, -4 and -7 (note TIROS 7 data are not yet available).

1.1 Data Product Description

The TIROS Level-1 Low-Resolution Omnidirectional Radiometer Temperature Data products contain the black and white sensor temperature values obtained from the hemispheric bolometers. Each temperature value is located with respect to time, latitude and longitude. These data were used to study the Earth's heat budget. The data were originally created on IBM 7094 computers and copied to 7-track, 556 bpi tapes in IBM's BCD format. Subsequently these were written in ASCII text format and saved to 9-track tapes and 3840 tape cartridges . The data from these magnetic tapes were recovered and are now archived in digital files in their original file format.

The data products are available for the time periods from 12 July 1961 to 20 October 1961 (TIROS-3), 8 February 1962 to 28 June 1962 (TIROS-4), and 19 June 1963 to 29 August 1965 (TIROS-7). Each data file contains between 10 and 26 days of data. The principal investigator for the TIROS omnidirectional radiometer experiment was Verner E. Suomi from the University of Wisconsin.

These products were previously available from the NASA National Space Science Data Center (NSSDC) under the names TIROS 3 Omnidirectional Radiometer Temperature Files with the identifier ESAD-00187 (old id 61-017A-01A), TIROS 4 Omnidirectional Radiometer Temperature Files with the identifier ESAD-00252 (old id 62-002A-01A), and TIROS 7 Omnidirectional Radiometer Temperature Files with the identifier ESAD-00153 (old id 63-024A-01A).

1.1.1 Low Resolution Omnidirectional Radiometer

The TIROS low-resolution omnidirectional radiometer consisted primarily of two sets of bolometers in the form of hollow aluminum hemispheres, mounted on opposite sides of the spacecraft, whose optical axes were parallel to the spin axis. The bolometers were thermally isolated from but in close proximity to reflecting mirrors so that the hemispheres behaved very much like isolated spheres in space. The experiment was designed to measure the amount of solar energy absorbed, reflected, and emitted by the earth and its atmosphere. One bolometer in each set was painted black, and one was painted white. Both has a high absorptivity to the infrared radiation emitted from the earth. The black bolometer also had a high absorptivity for solar radiation, which provided for separation of the reflected and emitted radiation. The sensor temperatures were measured by thermistors fastened to the inside of the hollow hemispheres. The sensor temperatures, taken every 29 sec, were an average of the two temperatures from the matched thermistors.

The low-resolution omnidirectional radiometer was successfully flown on three TIROS satellites: TIROS-3 (launched 12 July 1961), TIROS-4 (launched 8 February 1962) and TIROS-7 (launched 19 June 1963). A similar instrument was carried on Explorer 7 (launched 13 October 1959).

1.1.2 TIROS Overview

TIROS-3

The third Television and InfraRed Observation Satellite (TIROS 3) was launched into orbit on July 12, 1961. TIROS 3 was a spin-stabilized meteorological spacecraft designed to test experimental television techniques and infrared equipment. The satellite was in the form of an 18-sided right prism, 107 cm in diameter and 56 cm high. The top and sides of the spacecraft were covered with approximately 9000 1-cm by 2-cm silicon solar cells. It was equipped with two independent television camera subsystems for taking cloudcover pictures, plus a two-channel low-resolution radiometer, an omnidirectional radiometer, and a five-channel infrared scanning radiometer. All three radiometers were used for measuring radiation from the earth and its atmosphere. The satellite spin rate was maintained between 8 and 12 rpm by use of five diametrically opposed pairs of small, solid-fuel thrusters. A magnetic attitude control device permitted the satellite spin axis to be oriented to within 1 to 2 deg of a predetermined attitude. The spacecraft performed normally until August 1961, when the omnidirectional radiometer began to fail. Performance was sporadic until January 23, 1962. It was deactivated on February 28, 1962.

TIROS 3 orbit characteristics:

- Perigee Altitude: 742 km
- Apogee Altitude: 812 km
- Orbital Period: 100.41 minutes
- Inclination: 47.90 degrees
- Eccentricity: 0.00489

TIROS-4

The fourth Television and InfraRed Observation Satellite (TIROS 4) was launched into orbit on February 8, 1962. Its design was similar to its predecessor TIROS 3, and was also equipped with the same experiments: two independent television camera subsystems for taking cloudcover pictures, plus a two-channel low-resolution radiometer, an omnidirectional radiometer, and a five-channel infrared scanning radiometer. With the exception of the degraded response of the five-channel scanning radiometer, the spacecraft performed normally until May 3, 1962, when one camera failed. On June 10, 1962, the other camera's tape recorder failed. The scanning radiometer provided usable data until June 30, 1962.

TIROS 4 orbit characteristics:

- Perigee Altitude: 712 km
- Apogee Altitude: 840 km
- Orbital Period: 100.00 minutes
- Inclination: 48.30 degrees
- Eccentricity: 0.00894

TIROS-7

The seventh Television and InfraRed Observation Satellite (TIROS 7) was launched into orbit on June 19, 1963. Its design was similar to its predecessors, and was outfitted with two independent television camera subsystems for taking cloudcover pictures, plus an omnidirectional radiometer and a five-channel scanning radiometer for measuring radiation from the earth and its atmosphere, as well as a Langmuir probe for measuring electron density and temperature. The spacecraft performed normally until December 31, 1965, and sporadically until February 3, 1967. The spacecraft was operated for an additional 1.5 years to collect engineering data and deactivated on June 3, 1968.

TIROS 7 orbit characteristics:

- Perigee Altitude: 621 km
- Apogee Altitude: 649 km
- Orbital Period: 97.40 minutes
- Inclination: 58.23 degrees
- Eccentricity: 0.00200

1.2 Algorithm Background

The TIROS low-resolution omnidirectinal radiometer data were generated from the spacecraft telemetry, attitude and orbital data. The data were originally processed on IBM 7094 computers, and subsequently copied to 6250 bpi 9-track tapes and 3480 tape cartridges for archival. More detailed information on the TIROS low resolution omnidirectional radiometer instrument and data processing can be found in section 6 (Suomi).

1.3 Data Disclaimer

Users should cite this data product in their research:

Suomi, Verner E. (2021), TIROS3 Level 1 ORT Data V001, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: **[*Data Access Date*]**, https://doi.org/10.5067/8J551VOANJQR

Suomi, Verner E. (2021), TIROS4 Level 1 ORT Data V001, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: **[*Data Access Date*]**, https://doi.org/10.5067/EGCSHHHVLJKT

2. Data Organization

The TIROS low-resolution omnidirectional radiometer temperature data files contain between 10 and 26 days of data.

2.1 File Naming Convention

The data product files are named according to the following convention:

<Platform>_<Level>-<Type>_<DateStart>-<DateEnd>_<TapeNumber>-<FileNumber>.<Suffix>, where

o) Platform = name of the platform or satellite (TIROS3, TIROS4 or TIROS7)
o) Level = process level (L1)
o) Type =- Data type is Omnidirectional Radiometer Temperature (ORT) data
o) DateStart/End = Data start date and end date in format <YYYY>m<MMDD> where
1. YYYY = 4 digit year (1961)
2. MM = 2 digit month (01 - 12)
3. DD = 2 digit day of month (01 - 31)

o TapeNumber = 4 digit number of tape (preceded by 'DR' - primary or 'DS' - backup)
o FileNumber = 3 digit number of file on tape
o Suffix = the file format (always TAP, indicating tape binary data)

```
File name example: TIROS3_L1-ORT_1961m0712-1961m0723_DR3966-001.TAP
```

2.2 File Format and Structure

The data are stored as they were originally written in IBM binary (big-endian) record oriented structured files. The files were eventually written on 6250 bpi 9-track tapes or 3480 tape cartridges using a blocked FORTRAN format. Each tape has up to 5 files on it, with each file containing between 10 and 26 days of data. Each data file on the tape contains a set of data records with a FORTRAN record size word, the record block representing a line of ASCII text, and a FORTRAN record trailing size word. Files end with a single End-of-File word, the last file on the tape is followed by a double End-of-File word.

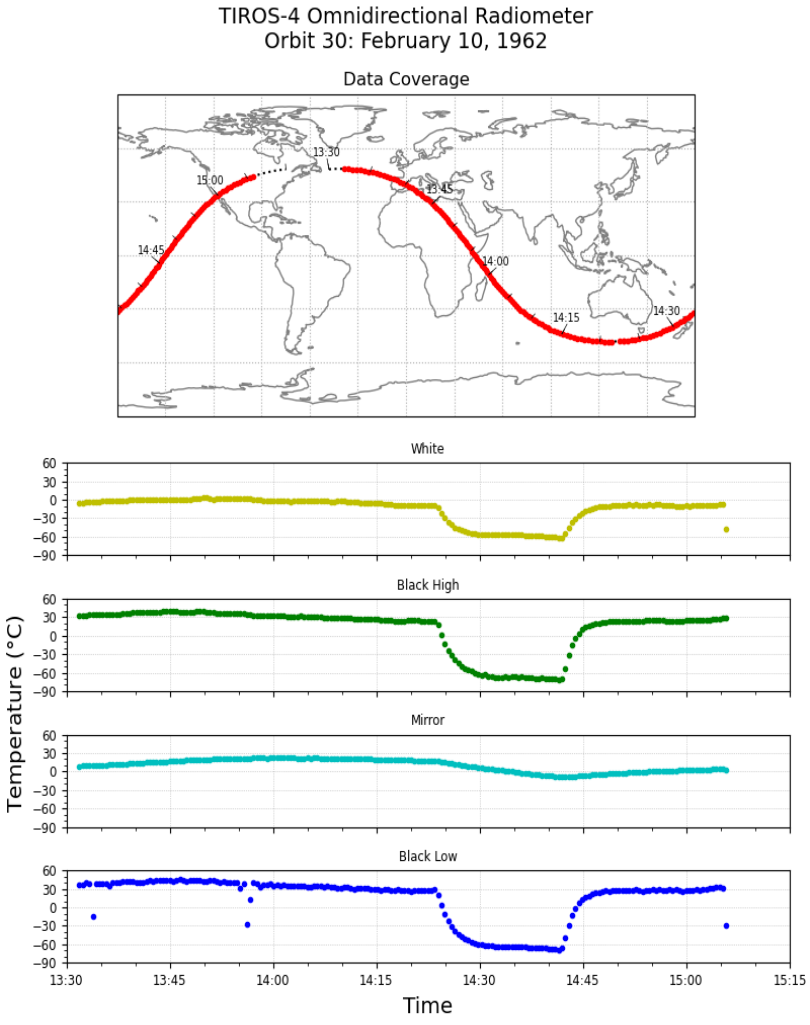
The lines of ASCII text make up a set tables of data with each table containing data for one orbit. The beginning of a table includes header information with the first line identifying the TIROS mission, followed by a blank line, a line with the orbit pass number, another blank line, a line with the date of the data, another blank line, and then five lines of header describing each column of data and then two blank lines. This is followed by rows containing the measured values listed in the header, time between each row is 29.5 seconds, the sampling rate of the instrument. A data file may contain between about 50 and 90 orbits of data, each in its own table. For the contents and layout of the data, see section 3.1 below.

During data recovery there were two sets of tapes, The first set of tapes are the primary tapes and designated with a DR (3480 tape cartridges) with 3 tapes (TIROS 3) containing 10 files (TIROS 3), and 4 tapes containing 10 files (TIROS 4). The second set are the backup tapes which are designated with a DS (9-track tapes) with 2 tapes and 5 files (TIROS 3), and x tapes and x files (TIROS 4). Each data has between about 50 and 90 orbits of data. During recovery the vast majority of DR and DS tape files were found to be exact or near duplicates (missing orbits tables or slightly corrupted) of each other, and five TIROS 3 DR tape files were found to be exact or near duplicates of other DR files. In the end there were 5 unique files from the primary DR tapes which represent the complete record of the TIROS 3, and 10 unique files from the primary DR tapes which represent the complete TIROS 4 Level 1 ORT data collections and these are publicly available from the GES DISC. The TIROS 7 ORT data have not yet been processed.

2.3 Key Science Data Fields

The primary science data fields are the bolometer sensor temperatures expressed in degrees Celsius.

Figure 1: Typical data coverage and temperatures for a TIROS Level 1 ORT orbit



3. Data Contents

The granularity for the ORT data is about ½ a month (10-26 days).

3.1 Data Records

No formal documentation describing the TIROS ORT data file format has been located. The summary below shows the typical layout of the TIROS orbit tables (one for each mission). A ‘1’ in the first column of a line indicates the beginning of a new orbit table.

The format is slightly different between TIROS 3 and 4. The former includes temperatures for both mirrors, and the local time of the measurement, whereas the latter includes calculated lat/lon of the center of the viewed scene, and only one mirror temperature. Aside from the time values which are integers, the other TIROS 3 values are recorded as floating points, but the TIROS 4 values are stored as scaled integers. Identification of the value REF. is unknown. Blank lines in TIROS 3 are displayed as 8 blank spaces followed by 4 zeros. Each example only shows the first 10 measurement times for the orbit.

1 TIROS III

0000

PASS NO. 56

0000

JULY 16, 1961

0000

TIME	SATELLITE COORDINATES			SPIN AXIS	NADIR ANGLE	SOLAR ELEV.	ZENITH ANGLE AT PC		UNIVERSITY OF WISCONSIN SENSOR DATA						LOCAL TIME
D H M S	LAT.	LONG.	HT.	SOLID ANGLE	RT. ASC.	DCL			REF.	WHITE HIGH	BLACK HIGH	MIRROR 1	BLACK LOW	MIRROR 2	

0000

0000

4	6	38	50	46.6	358.6	749.4	3.5	2.4	.1	95.3	8.4	69.0	7767.0	-26.1	18.7	-16.0	4.9	-14.9	6.6
4	6	39	19	47.0	1.0	750.0	3.5	2.4	.1	93.5	11.1	67.3	7778.0	0	19.7	-15.7	5.5	-14.3	6.7
4	6	39	49	47.3	3.4	750.6	3.5	2.4	.1	91.8	13.8	65.5	0	0	0	0	0	0	6.9
4	6	40	18	47.6	5.9	751.3	3.5	2.4	.1	90.0	16.3	63.7	7762.0	-25.1	20.8	-14.8	6.0	-13.3	7.1
4	6	40	48	47.8	8.4	752.0	3.5	2.4	.1	88.2	18.7	62.0	0	0	0	0	0	-7.6	7.2
4	6	41	17	47.9	10.9	752.6	3.5	2.4	.1	86.4	21.0	60.2	7760.0	-25.6	21.2	-13.9	4.9	-12.9	7.4
4	6	41	47	48.0	13.4	753.3	3.5	2.4	.1	84.7	23.3	58.4	0	-50.5	41.7	-17.0	0	23.7	7.6
4	6	42	16	48.0	16.0	754.0	3.5	2.4	.1	82.9	25.6	56.7	7762.5	-24.6	22.4	-13.1	6.1	-11.9	7.8
4	6	42	46	48.0	18.5	754.7	3.5	2.4	.1	81.1	27.8	54.9	0	0	0	0	5.9	-11.3	7.9
4	6	43	15	47.9	21.0	755.5	3.5	2.4	.1	79.4	30.0	53.1	0	0	22.6	-12.3	6.1	-10.8	8.1

1 TIROS IV

PASS NO. 226

FEB. 24, 1962

TIME	SATELLITE COORDINATES			PICT. CENTER COORDINATES		SPIN AXIS ANGLE	NADIR ELEV.	SOLAR ZENITH ANGLE AT PC		UNIV. OF WISCONSIN SENSOR DATA					
D H M S	LAT.	LONG.	HT.	SOLID ANGLE	LAT.	LONG.	RT. ASC.	DECL		REF.	WHITE HIGH	BLACK HIGH	BLACK LOW	MIRROR	

16	5	1	34	407	3323	815	339	0	0	60	-28	1530	0	1300	771430	-6692	-7907	-7278	-2033
16	5	2	3	415	3342	814	339	0	0	60	-28	1530	0	1283	771550	-6703	-8698	-7267	-2064
16	5	2	32	423	3362	812	339	0	0	60	-28	1528	0	1265	771600	-6671	-8508	-7260	-2112
16	5	3	2	431	3381	811	340	0	0	60	-28	1526	0	1248	771400	-6699	-8286	-7272	-2139
16	5	3	31	437	3402	809	340	0	0	60	-28	1522	0	1231	771400	-6703	-8793	-7265	-2180
16	5	4	0	444	3423	807	340	0	0	60	-28	1518	0	1213	771400	-6720	-8223	-7266	-2224
16	5	4	29	450	3445	806	340	0	0	60	-28	1513	0	1196	771400	-6717	-8603	-7274	-2249
16	5	4	58	456	3466	804	341	0	0	60	-28	1507	0	1179	771300	-6019	-6179	-5593	-2240
16	5	5	28	461	3489	802	341	0	0	60	-28	1500	0	1161	771450	-4830	-3703	-3393	-2184
16	5	5	57	466	3512	800	341	0	0	60	-28	1492	0	1144	771200	-4970	-1222	-5731	659

Table 3-1: TIROS 3 Columns

Column	Name	Description	Units	Scaling	Remarks
3-5	D	Day number since launch	-	-	0 = 12 July 1961
7-8	H	Hour of day	-	-	
10-11	M	Minute of hour	-	-	
13-14	S	Second of minute	-	-	
17-21	LAT.	Spacecraft latitude	degrees	-	-90 to +90
24-28	LONG.	Spacecraft longitude	degrees	-	-180 to +180
31-35	HT.	Spacecraft height	km	-	
38-40	SOLID ANGLE	Solid angle	steradians	-	
42-45	RT. ASC.	Right ascension of spin axis	hours	-	
47-48	DCL	Declination of spin axis	degrees	-	
50-54	NADIR ANGLE	Nadir angle	degrees	-	
56-60	SOLAR ELEV	Solar elevation at picture center	degrees	-	
62-66	ZENITH ANGLE	Zenith angle	degrees	-	
70-75	REF.	Unknown	?	-	
78-82	WHITE	White hemisphere bolometer temperature	Celsius	-	
85-89	BLACK HIGH	Black hemisphere bolometer high temperature	Celsius	-	
92-96	MIRROR 1	Mirror 1 temperature	Celsius	-	
99-103	BLACK LOW	Black hemisphere bolometer low temperature	Celsius	-	
106-110	MIRROR 2	Mirror 2 temperature	Celsius	-	
114-117	LOCAL TIME	Local time of measurement	hours	-	

Table 3-2: TIROS 4 Columns

Column	Name	Description	Units	Scaling	Remarks
3-5	D	Day number since launch	-	-	0 = 12 July 1961
7-8	H	Hour of day	-	-	
10-11	M	Minute of hour	-	-	
13-14	S	Second of minute	-	-	
18-21	LAT.	Spacecraft latitude	degrees	10	-90 to +90
24-27	LONG.	Spacecraft longitude	degrees	10	-180 to +180
31-33	HT.	Spacecraft height	km	1	
36-38	SOLID ANGLE	Solid angle	steradians	100	
42-45	PICT. CENTER LAT	Viewed latitude	degrees	10	-90 to +90
48-51	PICT. CENTER LONG.	Viewed longitude	degrees	10	-180 to +180
55-56	RT. ASC.	Right ascension of spin axis	hours	10	
59-61	DCL	Declination of spin axis	degrees	10	
64-67	NADIR ANGLE	Nadir angle	degrees	10	
71-73	SOLAR ELEV	Solar elevation at picture center	degrees	10	
77-80	ZENITH ANGLE	Zenith angle	degrees	10	
83-88	REF.	Unknown	?	100	
92-96	WHITE HIGH	White hemisphere bolometer high temperature	Celsius	100	
100-104	BLACK HIGH	Black hemisphere bolometer high temperature	Celsius	100	
108-112	BLACK LOW	Black hemisphere bolometer low temperature	Celsius	100	
116-120	MIRROR	Mirror temperature	Celsius	100	

3.2 Metadata

The metadata are contained in a separate XML formatted file having the same name as the data file with .xml appended to it.

Table 3-2: Metadata attributes associated with the data file.

Name	Description
LongName	Long name of the data product.
ShortName	Short name of the data product.
VersionID	Product or collection version.
GranuleID	Granule identifier, i.e. the name of the file.
Format	File format of the data file.
CheckSumType	Type of checksum used.
CheckSumValue	The value of the calculated checksum.
SizeBytesDataGranule	Size of the file or granule in bytes.
InsertDateTime	Date and time when the granule was inserted into the archive. The format for date is YYYY-MM-DD and time is hh-mm-ss.
ProductionDateTime	Date and time the file was produced in format YYYY-MM-DDThh:mm:ss.ssssssZ
RangeBeginningDate	Begin date when the data was collected in YYYY-MM-DD format.
RangeBeginningTime	Begin time of the date when the data was collected in hh-mm-ss format.
RangeEndingDate	End date when the data was collected in YYYY-MM-DD format.
RangeEndingTime	End time of the date when the data was collected in hh-mm-ss format.
PlatformShortName	Short name or acronym of the platform or satellite
InstrumentShortName	Short name or acronym of the instrument
SensorShortName	Short name or acronym of the sensor
WestBounding Coordinate	The westernmost longitude of the bounding rectangle(-180.0 to +180.0)
NorthBounding Coordinate	The northernmost latitude of the bounding rectangle(-90.0 to +90.0)
EastBounding Coordinate	The easternmost longitude of the bounding rectangle(-180.0 to +180.0)
SouthBounding Coordinate	The southernmost latitude of the bounding rectangle(-90.0 to +90.0)
Orbit	Orbit number range
ElapsedDays	Number of days in file.

4. Reading the Data

The data are written in a binary record-oriented format. Each record represents one line of text. The data were originally written in IBM BCD text, but were later converted to ASCII text format. Care should be taken as some lines of text do not always have columns that line up correctly, or may contain bad characters.

A sample FORTRAN program is included in the Appendix section which will read and print the the data contents.

Table 4-1: Orbit ranges for available tape files

File Name	No. Orbits	Orbit Range
TIROS3_L1-ORT_1961m0712-1961m0723_DR3966-001.TAP	63	1 – 156
TIROS3_L1-ORT_1961m0728-1961m0821_DR3966-002.TAP	84	226 – 570
TIROS3_L1-ORT_1961m0821-1961m0906_DR3966-003.TAP	70	579 – 812
TIROS3_L1-ORT_1961m0907-1961m1003_DR3967-001.TAP	82	821 – 1193
TIROS3_L1-ORT_1961m1006-1961m1020_DR3967-002.TAP	31	1230 – 1431
TIROS4_L1-ORT_1962m0208-1962m0223_DR3869-001.TAP	79	1 – 215
TIROS4_L1-ORT_1962m0223-1962m0310_DR3869-002.TAP	68	217 – 438
TIROS4_L1-ORT_1962m0311-1962m0325_DR3869-003.TAP	79	452 – 651
TIROS4_L1-ORT_1962m0325-1962m0406_DR3869-004.TAP	73	652 – 822
TIROS4_L1-ORT_1962m0406-1962m0426_DR3870-001.TAP	82	823 – 1107
TIROS4_L1-ORT_1962m0426-1962m0507_DR3870-002.TAP	75	1108 – 1265
TIROS4_L1-ORT_1962m0508-1962m0519_DR3870-003.TAP	67	1273 – 1433
TIROS4_L1-ORT_1962m0519-1962m0601_DR3870-004.TAP	79	1442 – 1618
TIROS4_L1-ORT_1962m0601-1962m0610_DR3871-001.TAP	67	1619 – 1755
TIROS4_L1-ORT_1962m0610-1962m0628_DR3871-002.TAP	50	1756 – 2009

5. Data Services

5.1 GES DISC Search

The GES DISC provides a keyword, spatial, temporal and advanced (event) searches through its unified search and download interface:

https://disc.gsfc.nasa.gov/

5.2 Documentation

The data product landing pages provide information about these data products, as well as links to download the data files and relevant documentation:

https://disc.gsfc.nasa.gov/datacollection/TIROS3L1ORT_001.html
https://disc.gsfc.nasa.gov/datacollection/TIROS4L1ORT_001.html
Note: TIROS 7 data are not yet available

5.3 Direct Download

These data products are available for users to download directly using HTTPS:

https://acdisc.gesdisc.eosdis.nasa.gov/data/TIROS/TIROS3L1ORT.001/
https://acdisc.gesdisc.eosdis.nasa.gov/data/TIROS/TIROS4L1ORT.001/
Note: TIROS 7 data are not yet available

6. More Information

6.1 Contact Information

Name: GES DISC Help Desk
URL: https://disc.gsfc.nasa.gov/
E-mail: gsfc-help-disc@lists.nasa.gov
Phone: 301-614-5224
Fax: 301-614-5228
Address: Goddard Earth Sciences Data and Information Services Center
Attn: Help Desk
Code 610.2
NASA Goddard Space Flight Center
Greenbelt, MD 20771, USA

6.2 References

See the NASA GSFC NSSDC entries for the TIROS low-resolution omnidirectional radiometers:

TIROS 3: https://nssdc.gsfc.nasa.gov/nmc/experiment/display.action?id=1961-017A-01

TIROS 4: https://nssdc.gsfc.nasa.gov/nmc/experiment/display.action?id=1962-002A-01

TIROS 7: https://nssdc.gsfc.nasa.gov/nmc/experiment/display.action?id=1963-024A-01

and the following documents:

Bandeen, W. R., M. Halev, and I. Strange, 1965: “A radiation climatology in the visible and infrared from the TIROS meteorological satellites”, NASA TN D-2534.

House, F. B., “The radiation balance of the earth from a satellite”, Ph.D. thesis, 69 pp., Dep. of Meteorol., Univ. of Wisc., Madison, 1965.

Sparkman, Barbara B., 1964: “Experimental analysis of the TIROS hemispheric sensor”, M.S. thesis, Department of Meteorology, The University of Wisconsin.

Suomi, V. E., K. J. Hanson and T. H. Vonder Haar, 1967: “The theoretical basis for low-resolution radiometer measurements from a satellite”, Annual Report. Grant NBG-27, Department of Meteorology, University of Wisconsin, 79- 100.

7. Appendices

Acknowledgments

The Nimbus data recovery task at the GES DISC is funded by NASA's Earth Science Data and Information System program.

Acronyms

EOS: Earth Observing System
ESDIS: Earth Science and Data Information System
GES DISC: Goddard Earth Sciences Data and Information Services Center
GSFC: Goddard Space Flight Center
L1: Level-1 Data
NASA: National Aeronautics and Space Administration
ORT: Omnidirectional Radiometer Temperature
TIROS: Television Infrared Observation Satellite
QA: Quality Assessment
UT: Universal Time

FORTRAN Code

```
C ^NAME: READ_ORT
C   This program reads TIROS Omnidirectional Radiometer Temperature files.
C
C   The TIROS Omnidirectional Radiometer Temperature files were created
C   for the TIROS-3, -4 and -7 missions. Each record contains a line of
C   ASCII text which make up a series of tables each with an orbit of data.
C   Tables have a header describing each column, rows are a measurement
C   taken every 29.5 seconds. There are slight differences in the
C   columns of each TIROS mission. This program will print the contents
C   of each data file.
C
C ^MAJOR VARIABLES:
C     FNAME  - name of input file
C     IRECSZ - size of record in bytes
C     BUFF   - buffer for data record
C     IOS    - I/O status number
C
C ^NOTES:
C     Compile: gfortran -o READ_ORT.EXE READ_ORT.FOR
C
C ^AUTHOR:  James Johnson (James.Johnson@nasa.gov), NASA GES DISC
C
C ^HISTORY: October 6, 2021 - first version
C-----------------------------------------------------------------------
      PROGRAM READ_ORT
      CHARACTER FNAME*1024                  ! Filename
      CHARACTER BUFF(128)                   ! Buffer for data record
      CHARACTER*128 LINE                    ! Line of text
      INTEGER*4 IRECSZ                      ! Size of records
      INTEGER*4 IWORD                       ! 4-byte word
      CHARACTER TEMP(4)                     ! Buffer to hold 4-byte word
      EQUIVALENCE (TEMP,IWORD)
      EQUIVALENCE (BUFF,LINE)


C     Get the name of the input data file to read
      WRITE (0, *), 'Enter the name of the input file:'
      READ (5,'(A)') FNAME

C     Open the specified input file
      OPEN (UNIT=1, FILE=FNAME, STATUS='OLD', ACCESS='DIRECT',
     &      FORM='UNFORMATTED', RECL=1, ERR=99, IOSTAT=IOS)

C     Initialize N (record number) and IOFF (byte offset in file)
      N=0
      IOFF=0

C     Loop through the file reading all records in file
      DO

C       Read the first 4-byte word or record size header
        DO I=1,4
          READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
          IRECSZ = IWORD
```

```
        END DO
        IOFF=IOFF+(I-1)
        IF (ISHFT(IWORD,-31) .EQ. 1) THEN                  ! Check Bit 31
          IRECSZ = IAND(IWORD,'7FFFFFFF'Z)
        END IF

C       End-of-File (EOF) mark, break out of do loop
        IF (IRECSZ .EQ. 0) GOTO 90

C       Next read the data record
        DO I=1,IRECSZ
          READ (1, REC=IOFF+I, IOSTAT=IOS) BUFF(I)
          IF (IOS .NE. 0) THEN
            PRINT '("ERROR: BUFF ",I4,X,I4,", IOSTAT: ",I6)', N,I-1,IOS
            IRECSZ = I-1
            GOTO 90
          END IF
        END DO
        IOFF=IOFF+(I-1)
        N=N+1

        PRINT '(A)', LINE(1:IRECSZ)

        DO I=1,4
          READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
        END DO
        IOFF=IOFF+(I-1)

      END DO

C     Close the input file
   90 CLOSE(1)
      STOP

   99 PRINT '("ERROR: OPEN FILE, IOSTAT: ",I6)', IOS
      STOP
      END
```