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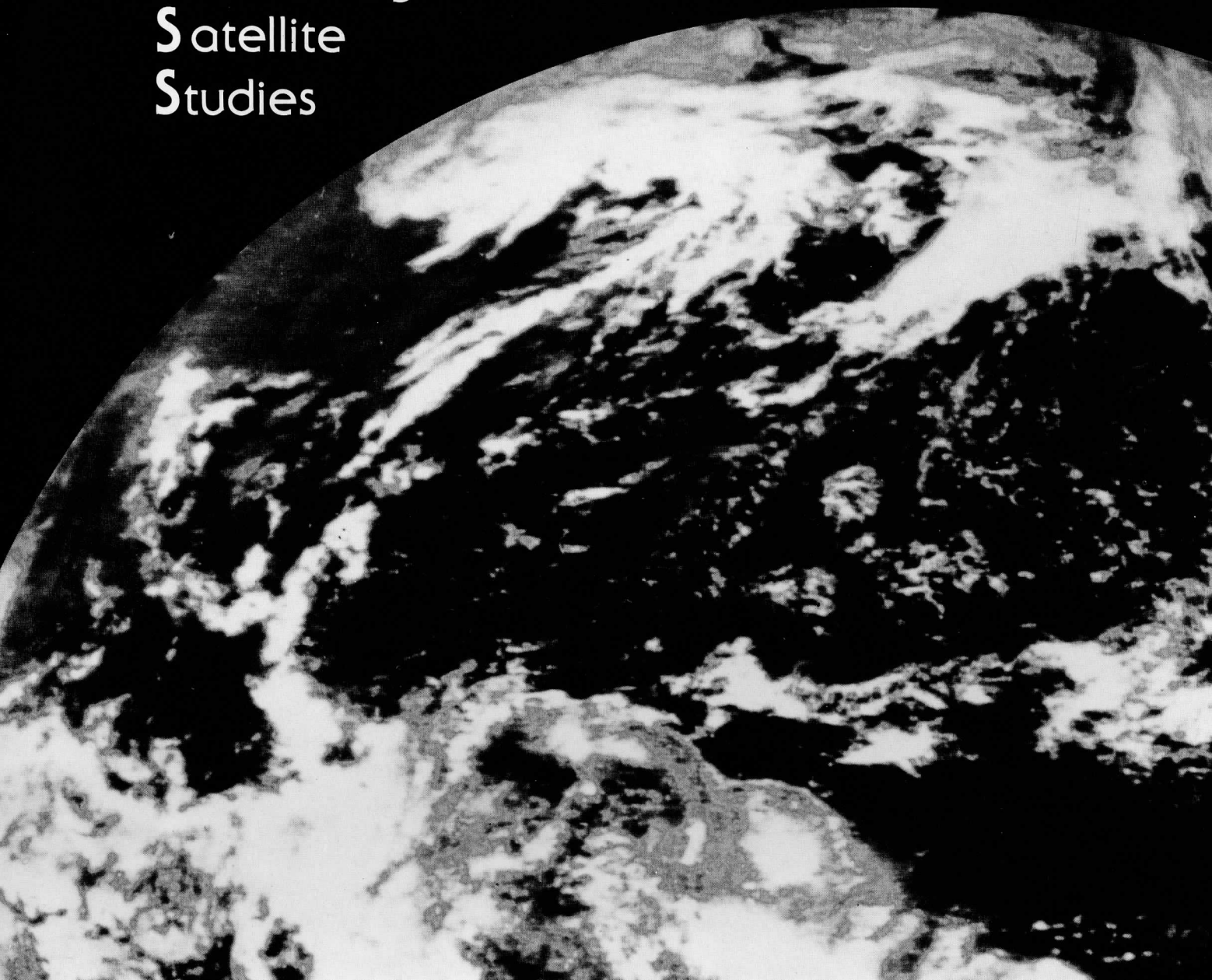
International TOVS Processing Package (ITPP) Software Description and Installation Guide

A REPORT from the

Cooperative
Institute for
Meteorological
Satellite
Studies



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VERSION 4.0, JANUARY 1990
This document is the first file in part 2 of the tape.

Major changes in this release:

1. Dynamic radiative-transfer tuning: GAMMA's (transmittance adjustment exponents) and channel error estimates have been fixed; DELTA's (brightness temperature bias adjustments) are determined for each retrieval location by regression.

There are two new routines, program 'TUNECF' and subroutine 'GETTUN,' as well as changes in some existing routines; version date is 01.01.90 for the new and modified software.

The bias-regressions are fixed for each satellite.

2. Improved moisture retrieval in program 'TOVRET' is based on separation of transmittances into wet and dry components. Early results of this scheme were reported at ITSC-IV; the procedure has been refined and is now considered operational. Relevant routines, version date 1.01.90, are 'GETMIX' (new) and 'HMTWR' (modified).

Major changes in prior release (version 3.3)

1. Navigation (earth-location): Subroutine 'SATPSN' has been replaced by a new version, based on a rigorous implementation of the Brouwer-Lyddane model employed by NESDIS operations. This new model eliminates the discontinuities occasionally produced by

the old procedure. New routines 'BROLYD', 'CELEM', and 'DKEPLR' are included.

*** NOTE: The FORTRAN source file immediately following 'BROLYD' is a BLOCK DATA element that serves to initialize several constants. It should be appended to, and compiled with, 'BROLYD'.

Because the new model requires orbital elements in a slightly different format, subroutine 'GETELE' has been modified accordingly. Subroutine 'ORBSET' is no longer needed, and has been eliminated; references to it have been deleted from 'INISHL' and 'ORBITS'.

2. NOAA-11: Subroutine 'MSUDAT' has been modified to include the new MSU serial number. This parameter has been found to vary, with no apparent impact on data quality; provision has been made in 'MSUDAT' (and program 'PREING' which calls it) to proceed with processing in spite of the inconsistency. Channels 10 and 17 of HIRS are different from previous spacecraft; appropriate changes have been made in 'HIRING', 'HIRLC', 'HIRPRE', and 'INIBLK'. Coefficients for NOAA-11 are contained in Part 3 of this tape.

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VERSION 4.0, JANUARY 1990

This document describes, in brief outline form, procedures for establishing a local/regional system for processing TOVS (HIRS + MSU) sounding data from the TIROS-N/NOAA series of polar-orbiting spacecraft, using the software in part 1 of this tape, and the supporting data contained in subsequent files on this tape (parts 2 and 3).

The algorithms and data-processing techniques were originally developed for 'McIDAS' (Man-computer Interactive Data Access System) at the Space Science and Engineering Center of the University of Wisconsin in Madison (UW/SSEC). Initially based on the Harris 'Slash-6' mini-computer, McIDAS is currently implemented on the IBM 4381 at the SSEC. The original 'export' software was configured for an IBM-OS system to provide the most reasonable portability, given the resources available to those responsible for its maintenance. The package contained in this tape has been modified to expedite its implementation on a VAX system.

Questions and/or comments concerning the system and its implementation, especially in regard to possible errors, should be addressed to:

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Contents of the remaining files in this portion of the tape:

File 2. Low-resolution (60 naut.Mi.) global topography
File 3. High-resolution (10 naut.Mi.) topography bit map, Nor.Hem.
File 4. High-resolution (10 naut.Mi.) topography heights, Nor.Hem.
File 5. High-resolution (10 naut.Mi.) topography bit map, Sou.Hem.
File 6. High-resolution (10 naut.Mi.) topography heights, Sou.Hem.

Notes on FORTRAN Source (Part 1)

Each routine is now in a separate file on the tape. This is a major departure from previous releases, in which all main programs were in one file, all subroutines in one file, and all functions in another. The new structure should simplify installation and/or updating of routines.

Observe that in most routines in which a file is opened, the 'OPEN' statement is not employed directly; rather, a call is made to subroutine 'OPEND'. This artifice has been employed as part of a major restruct uring of the ITPP software at CIMSS, in which the original IBM version has been upgraded to FORTRAN-77 in order to achieve more compatibility with the 'domestic' TOVS software and the VAX ITPP, both of which were already in FORTRAN-77. While there are still some differences at the main-program level, it has been possible, through this change, to establish a single version for many routines. The user may replace these calls with explicit 'OPEN' statements if desired.

The first card of each main program has the form

PROGRAM XXXXXX

Each main program and subprogram contains a comment card of the form

C ** VERSION OF DD.MM.YY (DAY.MONTH.YEAR)**

Users for whom this is not the first package supplied will find the 'version-dates' an indispensable means of determining which routines have been changed since their initial implementation. Although in the past updates to the package have been provided in the form of selected software and coefficients, the most recent changes are too extensive, and the number of users world-wide too great, to permit such 'limited-edition' updating. Therefore, updates - to software, coefficients, or both - are in the form of a new total-package tape. It is left to individual users to determine which 'new items' are relevant.

Notes on Supporting Data Files

A new high-resolution (10 naut.mi.) topography scheme has been implemented that requires only one-fourth the disk space of the original. The standard package contains complete datasets for both northern and southern hemispheres (see note below regarding installation).

Coefficient/parameter files for the ITPP (part 3) will be found following the topography files.

For each satellite in the series, there is a set of ten files as defined below. The current tape is valid for TIROS-N through NOAA-11 (seven spacecraft), and thus contains 70 coefficient files in addition to the basic files noted above. A double E-O-F terminates the tape. Note that the following file numbers are relative within each group.

File 1. Orbital elements
File 2. Ingest parameters
File 3. Coefficients for HIRS radiative-transfer computations
File 4. Coefficients for MSU (nadir) radiative-transfer comp
File 5. Coefficients for MSU (slant) radiative-transfer comp
File 6. Coefficients for HIRS limb-correction
File 7. Coefficients for MSU limb-correction
File 8. Synthetic coefficients for physical retrieval
File 9. Synthetic coefficients for statistical retrieval
File 10. Radiative-transfer tuning coefficients

The coefficients in files 2 through 10 are determined initially for each satellite, and can be considered fixed for its operational lifetime unless major changes occur in the performance of one or more spectral channels.* Orbital elements in file 1 (updated weekly) are needed for navigation (earth-location) of real-time data obtained via direct read-out of the spacecraft (VHF or HRPT). The elements included on this tape are provided to assist in initial implementation of the system; users must make their own arrangements for continued acquisition of that information for real-time applications.

*Occasionally, some of the MSU calibration quality-control limits in file 2 may need to be adjusted to avoid discarding good data as a result of changes in gain or other instrument characteristics. Programs 'XMSUIP' and 'UMSUIP' are provided to permit examination and modification, respectively, of those parameters.

Constructing the TOVS Data Processing System

The system makes extensive use of unformatted, direct-access disk files for efficiency in I/O operations. To assist in establishing the permanent data files (orbital elements, coefficients, and topography), software has been provided to read the data from ASCII files extracted from the tape, and write to binary disk files.

Program	Tape File	ASCII file(s)	Binary file(s)
TOPOGF	2	TOPOLRES.ASC	TOPOLRES.DAT
TOPOGH++	3+	BMAPTOPN.ASC	BMAPTOPN.DAT
	4+	HRESTOPN.ASC	HRESTOPN.DAT
	5+	BMAPTOPS.ASC	BMAPTOPS.DAT
	6+	HRESTOPS.ASC	HRESTOPS.DAT
PUTELE	1*	ORBELNXX.ASC	ORBELNXX.DAT (XX=05,06,...)
INGPAR	2	INGEPAXX.ASC	INGEPARM.DAT
HIRTCF	3	HIRTCOXX.ASC	HIRTCOEF.DAT
MSUTCF	4	MSUTCOXX.ASC	MSUTCOEF.DAT
MSZTCF	5	MSZTCOXX.ASC	MSZTCOEF.DAT
HIRLCF	6	HIRLCOXX.ASC	HIRLCOEF.DAT
MSULCF	7	MSULCOXX.ASC	MSULCOEF.DAT
RTVCFS	8	RTVSCOXX.ASC	RTVSCOEF.DAT
RTVCFL	9	RTVLCOXX.ASC	RTVLCOEF.DAT
TUNECF	10	TUNECOXX.ASC	TUNECOEF.DAT

Notes:
+ In the basic group (first six files in part 2 of the tape)
++If global topography is not required, the user should establish only the hemisphere he needs, and in subroutine 'NTOPO' of program 'TOVRET' replace the call to subroutine 'HRTOPO' with a direct call to 'HRTOPN' (northern hemisphere) or 'HRTOPS' (southern hemisphere).
*Within a satellite-specific group

Nearly all of the software provided in part 1 is for processing HIRS and MSU data to obtain profiles of atmospheric temperature, humidity, geopotential height, and geostrophic wind, and for displaying and manipulating those profiles in various ways. Essential operations are 'ingest,' 'preprocessing,' and 'retrieval.' The term 'RTC' stands for radiative-transfer coefficients, and 'LCC' stands for limb-correction coefficients. Where input parameters are required, programs prompt for keyboard input in the interactive mode of execution. If batch operation is desired, the user must make the necessary changes.

RAOHIR and RAOMSU (second and third from last FORTRAN-source files) are supplied to demonstrate the procedures for calculating, from radiosonde tempera-

ture and humidity profiles, HIRS radiances and brightness (equivalent-blackbody) temperatures, and MSU antenna or brightness temperatures, respectively.

Ingest

Function: produce calibrated, earth-located HIRS and MSU radiometric measurements from TOVS 'TIP' data. Two versions are provided; the essential difference is in the type of input data they are designed to handle - either archival ('level 1-b') or direct-readout (real time).

Program	Input(s)	Output(s)	( ) = LUN
ORBITS	*orb-elem(11) prompts	printout of subsatellite tracks for spacecraft, space and time windows obtained from prompts	

* Updated by program 'PUTELE' with data obtained from Direct Readout User Services.

Level 1-b: data that has been through preliminary processing by NESDIS operations' TOVS ground system, and is provided on standard computer tape to users, upon request, by the Satellite Data Services Branch of NESDIS. Such tape contains, in addition to values (in digital counts) representing radiometric measurements, earth-location information and calibration parameters required to transform the raw data values into radiance or brightness temperature. Three programs are supplied for this type of operation:

Program	Input(s)	Output(s)	( ) = LUN
INVTAP	1-b tape(10) *prompts	Printout of data type, times, and locations for each file	
TOVTAP	1-b tape(10) **prompts	selected HIRS(11) and MSU(12) data on disk; printout of relevant information	
TOVING	HIRS disk(11) MSU disk(12) HIRS RTC(13) ***prompts	calibrated, located data on disk(20); printout	

Notes:
* Number of files to read; program terminates on double EOF if encountered before count is satisfied.
**Physical file numbers of HIRS and MSU data, plus beginning and ending times.
***Satellite number (use 5 for TIROS-N) -- required because information in tape header records is confusing, i.e., TIROS-N is 1; NOAA-6 is 2; 7 is 4; 8 is 6; 9 is 7; 10 is 8.

Direct-readout: data obtained on-site by direct downlink from the spacecraft. The SSEC system uses data from the VHF (137MHz) beacon. Such data can also be acquired by extracting 'TIP' from an HRPT datastream; a model of the necessary software is provided as a guide to the user. Processing of direct-readout data is much more complex than that of level 1-b, since the user must do everything - decommutation of raw data, navigation or earth-location, and in-flight calibration. Three programs are supplied:

Program	Input(s)	Output(s)
PRETIP	HRPT file	disk file(9) containing TIP data

Note: the subroutines 'CMHOPN', 'CMHSET', and 'CMHGET', referenced in this program, are not included. The program is supplied to indicate the processing required to extract TIP data from the HRPT stream; software to perform that function is highly installation-dependent and must be provided by the user.

Program	Input(s)	Output(s)
PREING	disk file(9) *prompts	disk file(10) containing decommutated HIRS and MSU data printout
INGTOV	decom data(10) **orb-elem(11) HIRS RTC(13) ing-param(15)	calibrated, located data on disk(20) printout

Notes:
*Year; flag for detailed (diagnostic) MSU printout.
**Updated by program 'PUTELE' with data obtained from Direct Readout User Services.

The data in file 20 will have the same format, regardless of the source and type of ingest. This file serves as input to the next step.

Preprocessor

Function: transform calibrated, earth-located HIRS and MSU measurements produced by ingest, into datasets for display and retrieval. The imager (TOVORB), sounder (TOVSND), and retrieval (TOVRET) file names have been structured to permit up to 26 on-line datasets, by incorporating a letter from 'A' to 'Z' into a root. TOVPRE and subsequent programs prompt for a 'file letter' to point to a specific set.

Program	Input(s)	Output(s)
TOVPRE	ingest output (20) HIRS RTC(13 HIRS LCC(15) MSU LCC(16) lo-res topog(17) prompts for file, limb-corrn option	imager file(22) sounder file(23) printout
TOVMAP	imager file(22) prompts for file, param(s), start-line	printout of data in (line, element) coordinates
BRITEM	sounder file(23) prompts for file, location	display of all TBBs at one point

Note: the preprocessor performs the following functions:

If the MSU 'limb-correction' flag is on, MSU data are corrected for antenna pattern (transform antenna temp. to brightness temp.); limb effects (normalize to theta = 0); surface reflectivity (normalize to sfc.emis. = 1); liquid water (precipitating cloud) attenuation. If the HIRS 'limb-correction' flag is on, HIRS data are corrected for limb effects, and water vapor attenuation in the window channels.

In addition, HIRS channels 17 and 18 are corrected, in daylight, for fluorescence and reflected sunlight, respectively, regardless of the state of the limb-correction flag.

MSU and HIRS are colocated by interpolating the MSU observations to the HIRS scan pattern.

Output file 22 has all data for one parameter contiguous on disk, and thus is optimized for imaging; output file 23 has all data for one scan spot contiguous on disk, and, thus, is optimized for sounding.

Programs 'MSUPRO' and 'MSUPLT' perform functions similar to those of TOVPRE and TOVMAP, but for MSU only, which was the data available for major portions of the lifetimes of NOAA-6 and NOAA-8.

Retrieval

Function: determine, from preprocessed HIRS and MSU data, vertical profiles of atmospheric temperature, humidity, and geopotential height, as well as total ozone and stability parameters, at high spatial resolution. See note on 'surface data' at the end of this document. There are two very different retrieval programs included in this package: statistical (TOVSTR) and physical (TOVRET).

Program	Input(s)	Output(s)
TOVSTR	lo-res topog(17) imager file(22) sounder file(23) *rtvl coef(25) prompts for file, parameters	retrieval file(24) printout

TOVSTR is a fast statistical retrieval, using the N* procedure to obtain clear-column radiances. It is much less demanding of computer resources than the physical retrieval program, TOVRET. Data provided to this program must have been limb-corrected in TOVPRE.

Note: *coefficients staged to disk by 'RTVCFL'

Program	Input(s)	Output(s)
TOVRET	HIRS RTC(13) *MSU RTC(14) +HIRS LCC(15) +MSU LCC(16) lo-res topog(17) *MSU RTC(18) hi-res topog(27,37) imager file(22) sounder file(23) **rtvl coef(25) ***tune coef(30) ****prompts for file, parameters	retrieval file(24) printout

This program can operate on HIRS and MSU data that have been limb-corrected or not...the latter seems to give better results.

Notes:
* The RTC in file 14 are for limb-corrected MSU data; those in file 18, for non-limb-corrected data.
+Needed for regression estimation of first-guess temperature and ozone profiles.
** Coefficients staged to disk by 'RTVCFS'
*** Coefficients staged to disk by 'TUNECF'
****Specify various options to control execution of program - see source code for parameters and their meanings.

TOVRET is our most up-to-date model; it obtains solutions for temperature and water vapor in a single step from combined infrared and microwave measurements.

Program 'MSURET' performs a physical (iterative) retrieval on MSU-only data processed by MSUPRO.

Filtering

Function: eliminate soundings of questionable reliability by objective analysis of differences between infrared and microwave retrievals for the same location, and of variability in 1000-500mb thickness and longwave-window vs. surface temperature.

Program	Input(s)	Output(s)
FILRET	rtvl file(24) *prompts printout	rtvl file(24), with 'failed' soundings flagged

Note: *To control filtering parameters...see source code for details.

Enhancement

Function: add microwave-only soundings in areas where infrared retrievals were not made, owing to heavy cloudiness, or were flagged 'failed' by the filter program. This program was originally developed when only statistical retrievals could be made (by TOVSTR); if the physical retrieval TOVRET is used, enhancement should not be needed.

Program	Input(s)	Output(s)
ENHRET	lo-res topog(17) sounder file(23) rtvl file(24) *rtvl coef(25) prompt for file	rtvl file(24)

Note: *Same coefficients as used with TOVSTR

Geostrophic Winds

Function: determine geostrophic winds for 'good' soundings in retrieval file, by least-squares objective analysis of height fields.

Program	Input(s)	Output(s)
WINRET	tvl file(24) *prompts	rtvl file(24)

Note: *To control quantity of printout

Redundancy Elimination

Function: eliminate redundant infrared retrievals, based on variability in selected HIRS channels.

Program	Input(s)	Output(s)
REDRET	rtvl file(24) *prompts	rtvl file(24)

Note: *For file and to specify other than default control parameters

Retrieval Plotters

Function: to plot various quantities from the retrieval file. Input consists of the retrieval file(24) and prompts to control the location and parameters plotted... See source code for details.

Program	Product
TOVPLF	IR-MW sounding differences, with characters appended to denote results of FILRET and REDRET
TOVPLT	Retrieval temperatures

TOVPLF should be run before the next program to be described (COMRET); TOVPLT should be run after file-compression. The latter program may be replicated and/or modified to plot other quantities from the retrieval output.

File Compression

Function: compress the retrieval file by deleting soundings that have been flagged by FILRET and/or REDRET, and moving the remaining soundings to replace the 'empty' records.

Program	Input(s)	Output(s)
COMRET	rtvl file(24)	rtvl file(24)

Note on 'Surface Data'

Programs ENHRET, TOVRET, and TOVSTR invoke subroutine GETSFX, which is obviously, from inspection of the source code, a dummy routine. The user should provide an interface to actual gridded surface data (1000mb height, temperature, and dewpoint) if such information is available.

Structure of the 'TOVSINGO' File (output of INGTOV/TOVING)

- access method: FORTRAN direct-access I/O
- record length = 112 INTEGER*4 words

Record 1: HIRS header

WORD(S)	CONTENT
1	NOAA satellite number
2	number of records following that contain data (NRECH)
3	direction (1 = ascending, -1 = descending)
4	start time (seconds x 64)
5	start date (YYDDD)
6	end time (seconds x 64)
7	end date (YYDDD)
8	calibration (1 = occurred at least once)
9	logical sum of errors encountered
10	spare (0)
11	number of records read from input file
12	number of undefined/unrecognized encoder positions
13	start time (milliseconds)
14-112	spare (0)

Organization of HIRS data in records 2 through NRECH+1:

Each record contains data for 4 individual fields of view (IFOVs). The last such record may not be full; unused locations are zero-filled. Brightness temperatures are deg x 100.

IFOV sub-record (28 words):

WORD(S)	CONTENT
1	line*65536+spot (i.e., two 16-bit quantities)
2-20	brightness temperatures, channels 1 through 19
21	channel 20 (visible) radiance (mw/m**2-sr-cm**-1)
22	latitude (0-90, deg x 100, +N,-S)
23	longitude (0-180, deg x 100, +E,-W)
24	local zenith angle (deg x 100)
25	flag - see below for meaning of specific bits
26	date (YYDDD)
27	time (seconds x 64)
28	spare (0)

Consider the flag (word 25) as an array of 32 bits, with the most-significant designated 1, and the least-significant designated 32. If bit 25, 27, or 32 -- or any combination thereof -- is non-zero, the data in that IFOV should not be used. Other bits may be turned on (1) from time to time, but the conditions they denote do not affect the usability of the data.

If NRECH is less than 1400, all records from NRECH + 2 through 1401 are zero-filled.

Record 1402: MSU header

WORD(S)	CONTENT
1	NOAA satellite number
2	number of records following that contain data (NRECM)
3	direction (1 = ascending, -1 = descending)
4	start time (seconds x 64)
5	start date (YYDDD)
6	end time (seconds x 64)
7	end date (YYDDD)
8	spare (1)
9	spare (0)
10	number of records read from input file
11-112	spare (0)

Organization of MSU data in records 1403 through NRECM + 1402:

Each record contains data for an entire scan line of 11 IFOVs, with 10 words used for each and the last two words of the record zero-filled. Units and sign conventions are the same as for HIRS.

IFOV sub-record (10 words):

WORD(S)	CONTENT
1	line*65536 + spot
2	date
3	time
4	latitude
5	longitude
6	spare (0)
7-10	antenna temperatures, channels 1 through 4

Structure of the 'TOVORB' and 'TOVSND' files (output of TOVPRE)

*** TOVORB

- access routine: TSNIO
- record length = 112 INTEGER*4 words

Record 1: header

WORD(S)	CONTENT
1	YYDDD at start of pass
2	HHMMSS at start of pass
3	HHMMSS at end of pass
4	NLINES = number of HIRS lines in pass
5	NOAA satellite number
6	spare ... if non-zero, has significance only at CIMSS
7	direction (1 = ascending, 2 = descending)
50	start time of pass in milliseconds
51	HIRS limb-correction flag
52	MSU limb-correction flag
53-112	spare (0)

Organization of data in subsequent records:

There are 30 parameters, each of which is allotted 50 records on disk, providing for 100 HIRS scan lines (stored two lines per record). If the 'image' or orbital pass contains less than 100 lines, the unused portion of each 'logical (parameter) file' is filled with 999999 to serve as a 'missing' indicator to software that accesses the file.

The parameters are as follows (all brightness temps are deg x 100):

1	latitude (deg x 100, +N,-S)
2	longitude (deg x 100, +E,-W)
3	solar zenith angle (deg x 100; 9000 if night)
4-22	brightness temperatures, HIRS channels 1-19
23	brightness temperature, MSU channel 1a ... see below
24-27	brightness temperature, MSU channels 1 through 4
28	total outgoing longwave flux (watt/sq-meter, x 100)
29	bidirectional reflectance derived from HIRS channel 20(vis)

30 brightness temperature, HIRS channel 18a
... see below

Item 23: If MSU data are limb-corrected, this is channel 1 with surface effects retained; if not limb-corrected, this is indexing information and not mappable.

Item 30: If daytime, this is channel 18 (4 micron window) with a first-order approximate correction for reflected sunlight.

The access routine 'TSNIO' does the internal calculations to locate the data on disk, given parameter number, initial line, initial element, number of lines, and number of elements.

*** TOVSND

- access routine: SNDIO
- record length = 112 INTEGER*4 words

first record is 'header', and is identical to that for 'TOVORB'

Organization of data in subsequent records:

Parameters 1 through 28 (see 'TOVORB' description for contents) are stored as a vector with coordinates of line and element (or spot). Thus, each 112-word record contains data for four HIRS fields-of-view. The access routine 'SNDIO' does the internal calculations to locate the data on disk, given line and element.

Structure of the 'TOVRET' file

- access routine: RETIO
- record length = 112 INTEGER*4 words

Record 1: header

WORD(S)	CONTENT
1-52	same as TOVORB/TOVSND
53-108	spare (0)
109	line-coordinate of last sounding made
110	elem-coordinate of last sounding made
112	number of soundings made = NRET

Records 2 through NRET + 1:

All pressures are in units of millibars.
All temperatures are in units of degrees Kelvin x 100.
A value of 999999 denotes 'missing' or 'fill'.

WORD(S)	CONTENT
1	latitude (deg x 100, + N,-S)
2	longitude (deg x 100, + E,-W)
3	time (HHMM)
4	surface elevation (meters above MSL)
5-19	geopotential height (meters)
20	air temperature at ground level (or 1000 mb)
21-34	air temperature at 850, 700, ..., 10 mb
35	dew-point temperature at ground level (or 1000 mb)
36-40	dew-point temperature at 850, 700, ..., 300 mb
41-59	HIRS brightness temperatures, channels 1 - 19
60-63	MSU brightness temperatures, channels 1 - 4
64	surface skin temperature
65	image-line coordinate at center of retrieval box
66	image-element coordinate at center of box
67	pressure at ground level
68-77	first-guess temperature at 1000, 850, ..., 100 mb
78-82	first-guess dew-point at 850, 700, ..., 300 mb
83-90	fill
91	TOTAL-TOTALS stability index (deg x 100)
92-95	fill
96	total ozone (Dobson Units x 100)
97	total precipitable water vapor (mm x 100)
98	total outgoing longwave flux (watt/sq-meter, x 100)
99	cloud pressure
100	cloud temperature
101	fill
102	rtvl type (clear = 10, partly-cloudy = 20, MW + HS = 30)
103	solar zenith angle (deg x 100; 9000 if night)
104-112	winds (DDDFFF: deg,meters/sec)