University of Michigan
Space Physics Research Laboratory

TIDI Data Processing Software **Profile File Format**	CAGE No. 0TK63 Drawing No. 055-3532O Project TIDI Contract No. NASW-5-5049 Page 1 of 1

REVISION RECORD

Rev	Description	Date	Author
O	Added the comment "Please note that a positive value for the line of sight wind indicates that the wind is blowing toward the observer." To be thoroughly clear on direction of wind.	9 Sep 2007	M. Cooper
N	• Added self absorption flag to the global attributes.	3 Dec 2004	M. Cooper
M	• Add global attributes from control files • changed range of retrieved values to include mathematically possible negative values • Supply p_status bitmap information • Added explanation of optional variables to section 3.2.2 • Added description of filter wheel config.	18 Dec 2003	A. Marshall D. Gell
L	• Correct type of data_product_version from integer to string	22 Aug 2003	D. Gell
K	• Change length of table id variable to 4 bytes to permit table ids exceeding 32K • Add definitions of p_status values • Change version information to comply with convention • Indicate that all integers are signed integers	6 Jun 2003	D. Gell
J	• Add columns specifying the type of each variable • Add value to be used for missing data items • Added note about actual length of profile items • Specified names for dimensions	23 Apr 2003	D. Gell
I	• Change global attribute invarient_latitude_model to magnetic_latitude_model • Add ratio_source global attribute • Describe format for Rev ID attribute types • Delete ver1 and var_ver1 • Change ver2, var_ver2, back2 and var_back2 to refer to O2 atmospheric band • Add scalar variable containing ratio between (0-1) and (0-0) bands • remove earth_rot and earth_rot_var variables • remove temp_drift and temp_drift_var variables • changed att_s_var and att_h_var to global attributes • add the starting spectral record number for the used in the profile • Changed band nomenclature to form that may be included in netCDF files with no super- or sub-scripts • Defined all tbs items • Minor editorial changes	9 Mar 2001	D. Gell

H	• Add ion temperature • Add record index	22 Dec 2000	D. Gell
G	• Add profiles for derived density products • Removed altitude profile from profile record contents, consistent with version E • Amplified the description of the in_saa variable • Change name of variable alt to ref_alt to make it more descriptive of its function • Added profiles for density products • Corrected nomenclature for ver7 O^+ line • Correct specification of reference ellipsoid to WGS 84	14 Dec 2000	D. Gell
F	• Correct units for volume emission rate • Add note that contents of file consists solely of inverted profiles and ancillary data. • Changed name of wind speed variable from s to speed. • Add ion drift speed profile • Increase size of altitude profiles to 75 from 50 to contain recovery grid specified in 055-3997 . • Define the track angle as a continuous function	26 Oct 2000	D. Gell
E	• Define one altitude grid for file • Define arrays for volume emission rate for each species • Define background array for each species • removed inverted variable from profile records • removed emitter ID variable from profile records	18 Aug 2000	D. Gell
D	• Added inverted data indicator	16 May 2000	D. Gell
C	• changed file name extension to avoid conflicts with IDL • Note that a sample density indicator and a measure of the cross correlation between levels is needed and will be included in a future revision	13 April 2000	D. Gell
B1	• change abbreviation for Kelvins (unit of temperature) from °k to K	11 April 2000	D. Gell
B	• Delete CDL definition of file • Add dimensions and range to each profile data item • All short names are lower case • Add global attributes • Added duration of profile to record • Revise naming convention section to reference naming conventions document, 3345 • Added table of data item attributes	10 April 2000	D. Gell
A	Post Requirements Specification Review Revisions	13 Feb 1998	D. Gell
	Initial Release	9 Dec 1997	D. Gell

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1. References

1. Gell, David "Downlink Software Development Plan", SPRL File 055-3439, 29 July 1997

2. Russ Rew, Glen Davis, Steve Emmerson, and Harvey Davies, *NetCDF User's Guide for C, Version 3*, Unidata Program Center, June 1997

3. APL, *TIMED General Instrument Interface Specification (GIIS),* APL File 7363-9050, 1 Oct 1997

4. Gell, David, "File Naming Conventions Summary", SPRL File 055-3545, 3 Feb 1998

2. Introduction

The TIDI Profile Data File contains the results of the profile inversion program, INVERT, (reference 1). This program consumes level TIDI level 1b Line of Sight records and produces this level 2 file. During flight operations the level 1b data from which this file is produced will be formed from recorder playback data. During algorithm development, the level 1b data may be produced by simulators or emulators.

Profile files shall contain the inverted quantities as a function of altitude and ancillary data describing the state of the instrument and location of the measurement. The file contains volume emission rates and continuum backgrounds for only those atmospheric features that are retrieved. Variables relating to unretrieved atmospheric features will not be present in the file. The features which the TIDI instrument may observer are identified by the fw_config parameter. The features and the values are described in Section 3.

Profile files will generally contain data for a 24 hour period beginning at approximately 00h00 UTC. However, simulated data may be produced for shorter periods starting at arbitrary times.

3. Retrieved Features

The filter wheel configuration variable enumerates the atmospheric features that may be observed and retrieved. It is a unique number specified for each combination of filter wheel positions that provides valid measurement. Table 1, below, lists the emissions and filter wheel positions for each filter wheel configuration number. In the table the columns headed *FW 1* and *FW 2* are the positions of filter wheels 1 and 2 that correspond to the configuration number in the first column.

Table 1: Filter Wheel Configurations

fw_config	*FW 1*	*FW 2*	*Emission*	*Approx. filter center (nm in air)*	*Approx. filter width (nm)*
1	3	1	O_2 Atm (0-1) [$O_2(^1\Sigma)$(0-1)] P7 pair (11545.2971 and 11543.3255 cm^{-1}) Ar calibration (866.79 nm) Ne calibration (865.55224 nm)	866.12	0.3
2	1	1	O_2 Atm (0-1) [$O_2(^1\Sigma)$(0-1)] P11 pair (11531.7989 and 11536.7235 cm^{-1}) Ar calibration (866.79 nm)	867.133	0.3
3	8	1	O_2 Atm (0-0) [$O_2(^1\Sigma)$(0-0)] P9 pair	763.68	0.3

Table 1: Filter Wheel Configurations

fw_config	*FW 1*	*FW 2*	*Emission*	*Approx. filter center (nm in air)*	*Approx. filter width (nm)*
			(13093.6407 and 13091.6958 cm^{-1}) Ar calibration line (763.51 nm).		
4	4	1	O_2 Atm (0-0) [$O_2(^1\Sigma)$(0-0)] P15 pair (13069.9459 and 13068.0662 cm^{-1}).	765.07	0.3
5	5	1	OI(^{1}D) 630 nm red line Ne calibration (630.4789 nm)	630.1	0.5
6	7	1	OI(^{1}S) 557.7 nm green line	557.8	0.5
7	6	8	OII(^{2}D) 732 nm ionized O	732.1	0.5
8	6	7	OI [O ($^3S \rightarrow ^3P$)] 844.6 nm.	844.8	0.5
9	6	4	OH (9-4) P1(2) 779.4 nm	779.5	0.5
10	2	1	OH (7-3) P1(3) 891.9 nm Ne calibration (891.95007 nm)	892.1	0.5
11	6	5	Na D doublet Ar calibration (588.85841 nm) Kr calibration (558.18952 nm)	589.4	1.0
12	6	3	wideband O_2 Atm (0-0) P branch Ar calibration (763.51 nm)	764.0	4.0
13	6	2	wideband O_2 Atm (0-0) R branch Kr calibration (760.15 nm)	760.6	2.0
14	6	6	Kr calibration (557.02885 nm)	557.2	0.5
15	7	7	Dark	-	-

4. File Organization and Content

Profile Data will be stored in netCDF (ref. 2) files. These files are organized as if they contained a series of arrays, one array for each data item. In addition to the data, a netCDF file contains attributes. These attributes may be attached to a data item or they may be global, applying to the entire file. The minimum set of global attributes to be specified for the file is defined in an Appendix of the GIIS (ref. 3). The global attributes for this file are specified in section, 4.1 below

Attributes attached to each data item will include units, long name (description), maximum valid value, minimum valid value and missing value, as appropriate. The attributes and their definitions are specified in Table 2.

Table 2, Data Item Attributes	
attribute name	*description*
units	a string containing the standard abbreviations for the units associated with the data item
long_name	a string containing a description of the data item, sufficiently detailed that a knowledgeable outsider can interpret the description
valid_min	the minimum value ever expected of the data item
valid_max	the maximum value ever expected of the data item
missing_value	a value either greater than valid_max or less than valid_min used to fill the data item in the absence of valid data

These files consist of two logical segments, a "header" consisting of the global attributes and the data records. The minimum contents of the header are specified in an Appendix of the GIIS (ref.3).

4.1. File Header

The global attributes which constitute the header of the profile file are listed in Table 3, below. These attributes include those required by the GIIS and some TIDI unique items. Also recorded as global attributes are the control parameters supplied to the program when it was run. These parameters control the selection of the quantities to be retrieved, the altitude range over which to perform the retrieval and the constraints and other related parameters for the inversions. The global attributes which record the control parameters for day mode retrievals are listed in Table 4. The global attributes which record the control parameters for the night mode retrievals are listed in Table 5.

In the global attribute tables, the column labeled "Attribute Name" specifies the exact name to be used for the global attribute. The column labeled "Type" specifies whether the attribute is a character string, an integer number or a floating point number. In this column, items labeled Rev ID are a string consisting of a major revision number and a minor revision number separated by a decimal point. In the column labeled "Description", items in **bold courier** type are the exact constant value to be assigned to the attribute.

4.1.1. File Meta-Data

The first set of global attributes contain the file meta-data specified by the GIIS with some additional TIDI items. These items describe file and the data contained in it, including data version and revision information.

The date created field contains the time that the file was created, expressed in the TIMED standard ASCII format with fractional seconds omitted. Fields described as 'day modes' are used for processing data from daytime scan table ids, while 'night modes' are used for nighttime scans. Fields described as obsolete are not used in production processing, and should be ignored.

Table 3, File Meta-Data Global Attributes		
Attribute Name	*Type*	*Description*
`title`	String	text description of the data file
`data_product_type`	String	**ROUTINE, LEVEL2**
`mission`	String	**TIMED**

Table 3, File Meta-Data Global Attributes

Attribute Name	*Type*	*Description*
source	String	**TIDI_POC**
data_product_version	String	Version of the data product contained in the file. The version is a three digit number starting at 001 and incremented each time the data file is regenerated.
product_format_version	Rev ID	Version of the file format. Major format is incremented when a change in the reading software is required. Minor version is incremented when changes are implemented that do not require access software changes.
software_version	Rev ID	Major and Minor version numbers of the software used to produce the file
software_name	String	**INVERT**
calibration_version	String`	The string "**check CPF file name**" for the version. We do not have a calibration that can be versioned with RevID
filename	String	The name assigned to this file at the time of its creation.
input_file	String	The name of the input file processed to create this file.
cpf_filename	String	CPF filename used in the processing of this file.
date_created	String	yyyydoyhhmmss
magnetic_latitude_model	String	name of the magnetic model used to determine invariant latitude and magnetic longitude
solar_beta_angle	F4	The angle, in degrees, between the earth-sun line and the orbit plane at 12:00 UT on the first date in the file. Positive values indicate that the spacecraft is flying forward, negative values indicate backwards flight.
oband_ratio_source	String	**COMPUTED** | **CONSTANT**
day_control_file	String	The name of the file containing the inversion control parameters used for inverting day-side profiles.
night_control_file	String	The name of the file containing the inversion control parameters used for inverting night-side profiles.
att_s_var	F4	The estimated wind variance due to spacecraft attitude uncertainty in m^2s^{-2}
att_h_var	F4	The estimated tangent point altitude variance due to spacecraft attitude uncertainty in km^2
self_absorption	String	Self absorption flag. Set to either "ON" or "OFF". Controlled by command line parameter.

4.1.2. Control Attributes

In addition to the global attributes that describe the file, other attributes are used to record the parameters with which the program was run. These parameters are supplied to the program via control files whose names are recorded in the global attributes described in Table 3, above. The parameters that specify the operation of the program when operating on day mode data are listed in Table 4. The global parameters `model_vars, model_widths, invert_flags,` and `initial_guess_flags` are vectors. The length of these vectors is noted in the description column of the table.

Table 4, Day Mode Control Attributes

Attribute Name	*Type*	*Description*
`max_iter`	I4	Maximum number of iterations for inversion
`rswitch`	I4	User control of attempt to recover 0-1/0-0 ratio (1=recover, 0=use default) – day modes
`rval`	F4	Default value of 0-1/0-0 ratio – day modes
`lo_recov_alt`	F4	Lowest altitude allowed for LOS inputs, km – day modes
`hi_revoc_alt`	F4	Highest altitude allowed for LOS inputs, km – day modes
`model_str_ratio`	F4	Constraint weight for 0-1/0-0 ratio recovery – day modes
`model_vars`	F4	A 24 element vector containing the constraint weights for each of the day mode recoveries other than the (0-1)/(0-0) O2 band brightness ratio. The 24 values are in the following order: wind, Doppler temperature, rotational temperature, volume emission rate (8 of these, for ver2, ver4, ver3, ver7, ver8, ver6, ver5, and ver9), background (11 of these, one each for the four O_2 lines (at 11544, 11531, 13092, and 13069 cm^{-1}) , and back4, back3, back7, back8, back6, back5, and back9), ion wind, and ion temperature. The values can be thought of as variances, and are in the units appropriate for each recovery squared (m^2/s^2, deg^2, $(photons/cm^3/sec)^2$, or $(R/cm^{-1})^2$).
`model_widths`	F4	A 24 element vector containing the smoothing widths used for day mode recoveries. The 24 values are in the order indicated for 'model_vars'. The values are unitless, being the width of the off-diagonal spread in grid levels.
`invert_flags`	I4	A 55 element vector controlling which retrievals are to be performed for each day mode filter wheel configuration. A value of 1 indicates that the corresponding item is to be retrieved. A value of 0 indicates that the item is to be ignored. The 55 values are organized into one group of 5 for each of the 11 fw_config values. The 5 switches in each group are in the following order: line of sight wind, Doppler temperature, volume emission rate, background, and rotational temperature.
`initial_guess_flags`	I4	An 10 element vector containing switches that control the source of the initial guess to the fitting procedure for day modes. If 1, the calculated initial guess was replaced

Table 4, Day Mode Control Attributes		
Attribute Name	*Type*	*Description*
		with user supplied values from the init_guess_file. The 10 switches are in the following order: wind, temperature, ver2, ver4, ver3, ver7, ver8, ver6, ver5, and ver9. In production processing, these switches are always set to 0.
`init_guess_file`	String	Name of initial guess file for day modes. This file holds initial guesses for wind, temperature, and volume emission rates which can be used in place of calculated initial guesses. In production processing, this file is not used.
`atm_model_file`	String	Name of atmospheric model file for day modes. This file is not used in production processing.
`mode_table_file`	String	Name of mode table file for day modes. This file is not used for production processing.
`forw_model_output_file`	String	Name of forward model output file – day modes - note: this value is obsolete
`inv_model_output_file`	String	Name of inverse model output file – day modes – note: this value is obsolete
`noise_added`	I4	Is noise added to simulated spectra – day modes – note: this value is obsolete

The parameters that specify the operation of the program when operating on night mode data are listed in Table 5. The global parameters `model_vars_n, model_widths_n, invert_flags_n,` and `initial_guess_flags_n` are vectors. The length of these vectors is noted in the description column of the table. The names of the attributes are identical to those for the day mode with the addition of an `_n` suffix.

Table 5, Night Mode Control Attributes		
Attribute Name	*Type*	*Description*
`max_iter_n`	I4	Maximum number of iterations for inversion – night modes
`rswitch_n`	I4	User control of attempt to recover 0-1/0-0 ratio (1=recover, 0=use default) – night modes
`rval_n`	F4	Default value of 0-1/0-0 ratio – night modes
`lo_recov_alt_n`	F4	Lowest altitude allowed for LOS inputs, km – night modes
`hi_revoc_alt_n`	F4	Highest altitude allowed for LOS inputs, km – night modes
`model_str_ratio_n`	F4	Constraint weight for 0-1/0-0 ratio recovery – night modes

Table 5, Night Mode Control Attributes

Attribute Name	*Type*	*Description*
`model_vars_n`	F4	A 24 element vector containing the constraint weights for each of the night mode recoveries other than the (0-1)/(0-0) O2 band brightness ratio. The 24 values are in the following order: wind, Doppler temperature, rotational temperature, volume emission rate (8 of these, for ver2, ver4, ver3, ver7, ver8, ver6, ver5, and ver9), background (11 of these, one each for the four O_2 lines (at 11544, 11531, 13092, and 13069 cm^{-1}) , and back4, back3, back7, back8, back6, back5, and back9), ion wind, and ion temperature. The values can be thought of as variances, and are in the units appropriate for each recovery squared (m^2/s^2, deg^2, $(photons/cm^3/sec)^2$, or $(R/cm^{-1})^2$).
`model_widths_n`	F4	A 24 element vector containing the smoothing widths used for night mode recoveries. The 24 values are in the order indicated for 'model_vars'. The values are unitless, being the width of the off-diagonal spread in grid levels.
`invert_flags_n`	I4	A 55 element vector controlling which retrievals are to be performed for each filter wheel configuration for the night modes. A value of 1 indicates that the corresponding item is to be retrieved. A value of 0 indicates that the item is to be ignored. The 55 values are organized into one group of 5 for each of the 11 fw_config values. The 5 switches in each group are in the following order: line of sight wind, Doppler temperature, volume emission rate, background, and rotational temperature.
`initial_guess_flags_n`	I4	An 10 element vector containing switches that control the source of the initial guess to the fitting procedure for night modes. If 1, the calculated initial guess was replaced with user supplied values from the init_guess_file. The 10 switches are in the following order: wind, temperature, ver2, ver4, ver3, ver7, ver8, ver6, ver5, and ver9. In production processing, these switches are always set to 0.
`init_guess_file_n`	String	Name of initial guess file – night modes. In production processing, this file is not used.
`atm_model_file_n`	String	Name of atmospheric model file – night modes. In production processing, this file is not used.
`mode_table_file_n`	String	Name of mode table file – night modes. In production processing, this file is not used.
`forw_model_output_file_n`	String	Name of forward model output file – night modes note: this attribute is obsolete
`inv_model_output_file_n`	String	Name of inverse model output file – night modes this value is obsolete
`noise_added_n`	I4	Is noise added to simulated spectra for night modes note: this value is obsolete

4.2. Data Segment

The data segment consists of a retrieval altitude grid, described in section 4.2.1, and a set of profile records described in section 4.2.2. The retrieval altitude grid specifies the altitudes for which retrieved values may be present. No values will be present for altitudes other than those specified in the grid. There is one profile record for each measured profile.

In Table 6 and Table 7, which specify the contents of the retrieval grid variables and the profile variables, the columns specify the attributes of the data item. The short name is to be used as the variable name for the data item. The description is the string to be used as the netCDF `long_name` attribute. The units column specifies the string to be used as the netCDF `units` attribute. The type column indicates the type of the variable, where I indicates a signed integer type, C a character type and F a floating point type. The suffix digit indicates the length. A short integer in this notation is I2 and a single precision floating point number is F4. Arrays are dimensioned as shown in the dimension column. The range column defines a range of valid values for each item. These values shall be used as the `valid_min` and `valid_max` netCDF attributes. The value for the `missing_value` attribute shall be outside of the valid range and is indicated in the parenthesis following the range. Missing values specified for variance quantities shall be negative.

4.2.1. Retrieval Altitude Grid

The retrieval altitude grid is stored once and applies to every profile contained in the file. It is possible that a profile will not contain data at each altitude. In that case, the missing data value will be stored in the locations corresponding to altitudes for which no data exists. The retrieval altitude grid variable is specified in Table 6. The dimension noted in the table is the maximum value that the dimension may attain. The actual size of the array is specified by the named dimension `nalts`.

Table 6, Retrieval Altitude Grid

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
`alt_retrieved`	Altitude of each point in retrieval grid	km	F4	75	$0 \le x \le 600$ (-999)

4.2.2. Profile Data

The profile data consists of one logical record for each profile, containing inverted line of sight wind, Doppler temperature, rotational temperature, volume emission rate, and continuum background as retrieved from the spectra. The record also contains ancillary data describing the state of the instrument at the time of the measurement, the location of the measurement and the quality of the inversion.

The data is stored as a series of parallel arrays. The first dimension of each array is the record dimension and is omitted from the dimension column in Table 7. Vector items, such as each profile, are denoted in the table as having a dimension greater than 1 and are implemented as 2 dimensional netCDF arrays with dimension (unlimited, n) where n is the value in the column labeled *"dim"*. Scalar items, such as tangent point longitude, are denoted in the table as having a dimension of 1 and are one dimensional netCDF arrays with an unlimited dimension.

In a netCDF file, dimensions are named. The record dimension is named `nlos`. Strings are stored as arrays of bytes. the `ut_date` length dimension is named `date_len`. The one character long strings, such as flight direction, have a length dimension named `onechar`. Vectors expressed in the eci frame have a length dimension named `eci_len`. Profile items, such as `speed` and `t_rot` and `back1` have a length dimension named `nalts` which is the number of altitudes in the retrieval altitude grid. The value of `nalts` will not exceed 75. The dimension variable specifies the number of elements, not the index of the

last element. In languages with zero based array subscripts, such as C and IDL, the indices will run from 0 to one less than the specified dimension.

The profile record contents are described in Table 7. Since not all atmospheric features are observed, the related variables `ver`***n***`,` `var_ver`***n***`,` `back`***n***, and `var_back`***n*** may not be present in the file. In addition, the density products and ion drift speed variables are not present in all vector files. Programs written to read these vector files should use the netCDF inquiry routines to verify the presence of these variables before attempting to read them.

Please note that a positive value for the line of sight wind indicates that the wind is blowing toward the observer.

Table 7, Profile Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
time	date and time of the measurement	s since epoch‡	I4	1	x > 0 (-1)
ms_time	fractional second of the measurement	ms	I2	1	0 ≤ x ≤ 1000
ut_date	date of measurement, as a string in the form of YYYYdoy		C7	1	"1999001" ≤ x ≤ "2999366" (1999000)
ut_time	universal time of measurement	ms	I4	1	0 ≤ x ≤ 86400000 (-1)
rec_index	count of record in file	—	I4	1	x ≥ 1 (0)
duration	duration of the measurement, from the start of the first sample in the profile to the end of the final sample in the profile.	s	F4	1	0 ≤ x ≤ 3600 (-99)
data_ok	True if data is OK, False if data is contaminated		C1		"T" | "F" ("?")
lat	geodetic latitude assigned to the profile based on the wgs 84 ellipsoid.	deg	F4	1	|x| ≤ 90 (-99)
lon	east longitude assigned to the profile	deg	F4	1	0 ≤ x ≤ 360 (-99)
ref_alt	Note: this variable is obsolete	km	F4	1	0 ≤ x ≤ 10^4 (-99)
lst	local solar time assigned to the profile at position lat, lon and altitude ref_alt	hr	F4	1	0 ≤ x ≤ 24 (-99)
sza	solar zenith angle assigned to the profile at position lat, lon and altitude ref_alt	deg	F4	1	0 ≤ x ≤ 180 (-99)
sscat	solar scattering angle assigned to the profile at position lat, lon and altitude ref_alt	deg	F4	1	0 ≤ x ≤ 180 (-99)

‡ epoch is the GPS epoch, 0h00 UTC, 6 January 1980

Table 7, Profile Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
lza	lunar zenith angle assigned to the profile at position lat, lon and altitude ref_alt	deg	F4	1	$0 \le x \le 180$ (-99)
lscat	lunar scattering angle assigned to the profile at position lat, lon and altitude ref_alt	deg	F4	1	$0 \le x \le 180$ (-99)
ilat	magnetic latitude assigned to the profile at position lat, lon and altitude ref_alt	deg	F4	1	$\lvert x \rvert \le 90$ (-99)
mlon	magnetic longitude assigned to the profile at position lat, lon and altitude ref_alt	deg	F4	1	$0 \le x \le 360$ (-99)
track	track angle assigned to the profile, with a value of 360° at the first ascending node within the file	deg	F4	1	$x \ge 0$ (-99)
table_id	identifier of the scan table controlling the measurement	—	I4	1	$0 \le x \le 65535$ (-99)
flight_dir	flight direction		C1		"F" | "B" ("?")
ascending	True if spacecraft is on the ascending (northbound) leg		C1		"T" | "F" ("?")
in_saa	True if the spacecraft is in the south Atlantic anomaly		C1		"T" | "F" ("?")
tel_id	telescope azimuth, 1(45°), 2(135°), 3(225°), 4(315°)	deg	I2	1	45, 135, 225, 315 (-99)
start_spectra	the LOS file rec_index of the first spectra belonging to this profile	—	I4	1	$x > 0$ (-99)
los_direction	line of sight geographic azimuth, measured from north towards east	deg	F4	1	$0 \le x \le 360.$ (-99)
temp_ccd	CCD temperature	°C	F4	1	$-120 \le x \le 60$ (-999)
temp_preamp	CCD pre-amplifier temperature	°C	F4	1	$-120 \le x \le 60$ (-999)
temp_window	CCD window temperature	°C	F4	1	$-120 \le x \le 60$ (-999)
temp_fw_hsg	Filter wheel housing temperature	°C	F4	1	$-50 \le x \le 50$ (-99)
temp_etl_leaf	Etalon mount leaf temperature	°C	F4	1	$-50 \le x \le 50$ (-99)

Table 7, Profile Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
temp_etl_post	Etalon mount post temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_etl_rod	Etalon mount rod temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_base	Profiler base temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_barrel	Telescope mirror / barrel temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_pedestal	Telescope pedestal temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_pwr_sup	Instrument power supply temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_processor	Flight computer temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
temp_1553	Communications (1553) interface temperature	°C	F4	1	-50 ≤ x ≤ 50 (-99)
p_status	processing status value	—	I2	1	
oband_ratio	ratio of O_2 Atm (0-1) [$O_2(^1\Sigma)(0\text{-}1)$] to O_2 Atm (0-0) [$O_2(^1\Sigma)(0\text{-}0)$] brightness	—	F4	1	0 ≤ x ≤ 1.0 (-99)
speed	inverted wind along the line of sight at each level in profile - a positive value indicates that the wind is blowing toward the observer	$m\ s^{-1}$	F4	75	|x| ≤ 2000 (-9999)
var_speed	estimated variance of the inverted wind along the line of sight at each level in profile	$m^2\ s^{-2}$	F4	75	$0 \le x \le 10^6$ ($-9 \cdot 10^6$)
t_doppler	inverted line of sight Doppler temperature	K	F4	75	|x| ≤ 3000 (-9999)
var_t_doppler	estimated variance of the inverted Doppler temperature	K^2	F4	75	$0 \le x \le 10^6$ ($-9 \cdot 10^6$)
t_rot	inverted line of sight rotational temperature at each level in profile	K	F4	75	|x| ≤ 3000 (-9999)
var_t_rot	estimated variance of the inverted temperature at each level in profile	K^2	F4	75	$0 \le x \le 10^6$ ($-9 \cdot 10^6$)
drift	inverted ion drift speed along the line of sight at each level in profile	$m\ s^{-1}$	F4	75	|x| ≤ 2000 (-9999)
var_drift	estimated variance of the inverted ion drift speed along the line of sight at each level in profile	$m^2\ s^{-2}$	F4	75	$0 \le x \le 10^6$ ($-9 \cdot 10^6$)
t_ion	inverted line of sight ion temperature at each level in profile	K	F4	75	|x| ≤ 3000 (-9999)

Table 7, Profile Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
var_t_ion	estimated variance of the ion temperature at each level in profile	K^2	F4	75	$0 \le x \le 10^6$ $(-9 \cdot 10^6)$
back1	inverted line of sight background at 867 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^7$ $(-9 \cdot 10^7)$
var_back1	estimated variance of inverted line of sight 867 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9 \cdot 10^{14})$
ver2	estimated O_2 Atmospheric $[O_2\ (^1\Sigma)]$ band volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^6$ $(-9 \cdot 10^6)$
var_ver2	estimated O_2 Atmospheric $[O_2\ (^1\Sigma)]$ band volume emission rate variance at each level	(photons $cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^{12}$ $(-9 \cdot 10^{12})$
back2	inverted line of sight background at 762 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^7$ $(-9 \cdot 10^7)$
var_back2	estimated variance of the inverted line of sight 762 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9 \cdot 10^{14})$
ver3	estimated OI 557.7 nm $[O(^1S)]$ volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^4$ $(-9 \cdot 10^4)$
var_ver3	estimated OI 557.7 nm $[O(^1S)]$ volume emission rate variance at each level	(photons $cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^8$ $(-9 \cdot 10^8)$
back3	inverted line of sight background at 557.7 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^7$ $(-9 \cdot 10^7)$
var_back3	estimated variance of the inverted line of sight 557.7 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9 \cdot 10^{14})$
ver4	estimated OI 630.0 nm $[O(^1D)]$ volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^4$ $(-9 \cdot 10^4)$
var_ver4	estimated OI 630.0 nm $[O(^1D)]$ volume emission rate variance at each level	(photons $cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^8$ $(-9 \cdot 10^8)$
back4	inverted line of sight background at 630 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^7$ $(-9 \cdot 10^7)$
var_back4	estimated variance of the inverted line of sight 630 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9 \cdot 10^{14})$
ver5	estimated OH Meinel (7-3) P1(3) volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^4$ $(-9 \cdot 10^4)$
var_ver5	estimated OH Meinel (7-3) P1(3) volume emission rate variance at each level	(photons $cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^8$ $(-9 \cdot 10^8)$
back5	inverted line of sight background at 892 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^7$ $(-9 \cdot 10^7)$

Table 7, Profile Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
var_back5	estimated variance of the inverted line of sight 892 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9{\cdot}10^{14})$
ver6	estimated OH Meinel (9-4) P1(2) volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^{4}$ $(-9{\cdot}10^{4})$
var_ver6	estimated OH Meinel (9-4) P1(2) volume emission rate variance at each level	$(\text{photons } cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^{8}$ $(-9{\cdot}10^{8})$
back6	inverted line of sight background at 780 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^{7}$ $(-9{\cdot}10^{7})$
var_back6	estimated variance of the inverted line of sight 780 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9{\cdot}10^{14})$
ver7	estimated OII 732.0 nm [$O^+(^2P)$] volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^{3}$ $(-9{\cdot}10^{3})$
var_ver7	estimated OII 732.0 nm [$O^+(^2P)$] volume emission rate variance at each level	$(\text{photons } cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^{6}$ $(-9{\cdot}10^{6})$
back7	inverted line of sight background at 732 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^{7}$ $(-9{\cdot}10^{7})$
var_back7	estimated variance of the inverted line of sight 732 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9{\cdot}10^{14})$
ver8	estimated OI 844.6 nm [$O\ (^3S \rightarrow {}^3P)$] triplet volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^{4}$ $(-9{\cdot}10^{4})$
var_ver8	estimated OI 844.6 nm [$O\ (^3S \rightarrow {}^3P)$] triplet volume emission rate variance at each level	$(\text{photons } cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^{8}$ $(-9{\cdot}10^{8})$
back8	inverted line of sight background at 845 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^{7}$ $(-9{\cdot}10^{7})$
var_back8	estimated variance of the inverted line of sight 845nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9{\cdot}10^{14})$
ver9	estimated NaD doublet volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\lvert x \rvert \le 10^{4}$ $(-9{\cdot}10^{4})$
var_ver9	estimated NaD doublet volume emission rate variance at each level	$(\text{photons } cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^{8}$ $(-9{\cdot}10^{8})$
back9	inverted line of sight background at 589 nm	R/cm^{-1}	F4	75	$\lvert x \rvert \le 10^{7}$ $(-9{\cdot}10^{7})$
var_back9	estimated variance of the inverted line of sight 589 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ $(-9{\cdot}10^{14})$
o3density	recovered ozone density	cm^{-3}	F4	75	$\lvert x \rvert \le 10^{15}$ $(-9{\cdot}10^{15})$

Table 7, Profile Record Contents					
short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
var_o3density	estimated ozone density variance	$(cm^{-3})^2$	F4	75	$0 \le x \le 10^{15}$ $(-9 \cdot 10^{15})$
o1ddensity	recovered O^1D density	cm^{-3}	F4	75	$\lvert x \rvert \le 10^{16}$ $(-9 \cdot 10^{16})$
var_o1ddensity	estimated O^1D density variance	$(cm^{-3})^2$	F4	75	$0 \le x \le 10^{16}$ $(-9 \cdot 10^{16})$
o3pdensity	recovered O^3P density	cm^{-3}	F4	75	$\lvert x \rvert \le 10^{16}$ $(-9 \cdot 10^{16})$
var_o3pdensity	estimated O^3P density variance	$(cm^{-3})^2$	F4	75	$0 \le x \le 10^{16}$ $(-9 \cdot 10^{16})$
chi_square	estimated value of χ^2 for the fit	—	F4	1	$0 \le x \le 10^{6}$ $(-9 \cdot 10^{6})$

Notes: If the number of altitudes specified for the retrieval altitude grid is less than 75, he dimension of the profiles, specified above as 75, may be smaller.

Not all instances of ver***n***, var_ver***n***, back***n***, and var_back***n*** need be present in the file

The ion drift speed and variance drift and var_drift need not be present in the file

The density products need not be present in the file

A positive value for the line of sight wind indicates that the wind is blowing toward the observer.

4.2.3. Processing Status Bitmap, the p_status variable

The p_status variable is a bitmap that records the errors that occur in processing a TL0 file. The p_status variable is initially set to 0. The bitmap begins at bit 0 in FORTRAN and bits are set using the IBSET function. The table below indicates the meaning assigned to each bit. If the value of the bitwise and of p_status and the bit mask *[iand(p_status,mask)]* is non-zero the specified bit is set indicating that the noted condition occurred.

Table 8, Processing Status Bitmap (p_status)		
bit number	*bit mask*	*Description*
0	0001	set if the value of chi_square is greater than 100., indicating a bad fit

5. Naming Convention

File names consist of a file description string and a file type string separated by the period "." character. TIDI profile files have the file type ".PRF" and will be named according to the convention specified in reference 4.