REVISION RECORD			
Rev	Description	Date	Author
H	• Corrected description single character variables • Updated text	28 May 2008	M. L. Cooper
G	• Corrected description of calibration version attribute • Updated text • Retrieved variables can have negative values • Add table of dimension names	11 Dec 2003	D. A. Gell
F	• Added type and missing value columns to tables 3 and 4 • Reorganized section 3 to be consistent with profile file format document • Added explanation of optional variables to section 3.2.2	5 Dec 2003	D. A. Gell
E	• Change data_product_version to string and expand its description	22 Aug2003	D. A. Gell
D	• Add ion drift vector components • Remove references to O band ratio	1 Aug 2001	
C	• Change global attribute invariant_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 • add att_s_var and att_h_var to global attributes • 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	
B	• Add ion temperature • Add record index	22 Dec 2000	
A	Post requirements specification review revisions •Corrected data product type, changing level to 3 •Added profiles for all products in level 2 file •Simplified the description of the in_saa variable • Change name of variable alt to ref_alt to make it more descriptive of its function •Removed altitude profiles from records to separate altitude record. •Changed reference ellipsoid to TIMED standard wgs84	14 Dec 2000	

REVISION RECORD			
Rev	Description	Date	Author
	Initial Release	10 April 2000	

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1. References

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

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

2. Introduction

The TIDI Vector Data File contains the results of the wind vector construction program, VECTOR, (reference 1). This program consumes TIDI level 2 inverted profile records and produces this level 3 file.

Vector files contain data mapped onto an evenly spaced track angle grid. Data items include the wind transformed into zonal and meridional components, volume emission rates, continuum backgrounds, and ancillary data. Volume emission rates and continuum backgrounds are included for only those atmospheric features that are observed. Variables relating to unrecovered atmospheric features will not be present in the file.

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

3. File Organization and Content

Vector profiles 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, 3.1 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 1.

Table 1, 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).

3.1. File Header

The global attributes which constitute the header of the vector file are listed in Table 2 , below. These attributes include those required by the GIIS and some TIDI unique items. 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. The date created field contains the time that the file was created, expressed in the TIMED standard ASCII format with fraction seconds omitted.

Table 2, Global Attributes

Attribute Name	*Type*	*Description*
`title`	String	text description of the data file
`data_product_type`	String	**`ROUTINE, LEVEL3`**
`mission`	String	**`TIMED`**
`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.
`calibration_version`	String	The string "**`check CPF file name`**" for the version. We do not have a calibration that can be versioned with RevID
`software_version`	Rev ID	Major and Minor version numbers of the software used to produce the file
`software_name`	String	**`VECTOR`**
`calibration_version`	Rev ID	Major and Minor version numbers of the calibration data used in the production of this file
`filename`	String	The name assigned to this file at the time of its creation.
`input_file`	String	The name of the file processed to create 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.
`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
`map_spacing`	F4	The track angle interval between grid points
`startMT`	I4	The initial mission time in seconds since the GPS epoch
`endMT`	I4	The final mission time in seconds since the GPS epoch
`pvat_filename`	String	the name of the PVAT file from which the orbital elements are obtained

3.2. Data Segment

The data segment consists of a retrieval altitude grid, described in section 0, and a set of profile records described in section 3.2.2. 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 4and Table 5, 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.

In a netCDF file, the dimensions of an array are contained in named dimension variables. The dimension variables are listed and defined in Table 3.

Table 3, Dimension Names

dimension variable	*usage*
`nvec`	The record dimension of the profile records. The number of wind vector profiles in the file
`date_len`	The length of the ut_date character string
`onechar`	The length of a one character string
`nalts`	The number of altitudes in the retrieval profile.

3.2.1. 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 4. 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 4, 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)

3.2.2. Profile Data

The profile data consists of one logical record for each profile, containing the vector wind profile and profiles of temperatures, volume emission rate, and constituents smoothed along the track. 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 time of the measurement is defined to be the time when the spacecraft is at a position whose angle along the track is the same as that of the measurement.

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 5. 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.

The vector record contents are described in Table 5. Since not all atmospheric features are observed or recovered, 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.

Table 5, Vector 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 (-1)
`ut_date`	date of measurement, as a string in the form of YYYYdoy		C7	1	"1999001" ≤ x ≤ "2999366" (1900000)
`ut_time`	universal time of measurement	ms	I4	1	0 ≤ x ≤ 86400000 (-1)
`rec_index`	count of record in file	—	I4	1	x ≥ 1 (-99)
`data_ok`	True if data is OK, False if data is contaminated		C1		"T" | "F" ("?")
`lat`	geodetic latitude assigned to the profile	deg	F4	1	|x| ≤ 90 (-99)
`lon`	east longitude assigned to the profile	deg	F4	1	0 ≤ x ≤ 360 (-99)
`ref_alt`	*Unimplemented* representative height above the wgs 84 reference ellipsoid at which other ancillary data items are defined	km	F4	1	0≤ x ≤ 10000 (-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)

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

Table 5, Vector 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)
`ilat`	invariant 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	$0 \le x \le 360$ (-99)
`table_id`	identifier of the scan table controlling the measurement	—	I4	1	$0 \le x \le 65535$ (-99)
`measure_track`	identifies the side of the spacecraft viewed, either warm side or cold side	—	C1	1	"W" | "C" ("?")
`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" ("?")
`p_status`	processing status value (see section 3.2.3, page 12)	—	I4	1	
`u`	zonal wind at each level in profile	$m\ s^{-1}$	F4	75	$\lvert x \rvert \le 2000$ (-9999)
`var_u`	estimated variance of the zonal wind at each level in profile	$m^2\ s^{-2}$	F4	75	$0 \le x \le 10^6$ $(-9 \cdot 10^6)$
`v`	meridional wind at each level in profile	$m\ s^{-1}$	F4	75	$\lvert x \rvert \le 2000$ (-9999)
`var_v`	estimated variance of the meridional wind 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	$\lvert x \rvert \le 3000$ (-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	$\lvert x \rvert \le 3000$ (-9999)
`var_t_rot`	estimated temperature variance at each level in profile	K^2	F4	75	$0 \le x \le 10^6$ $(-9 \cdot 10^6)$
`u_drift`	zonal component of the ion drift velocity at each level in profile	$m\ s^{-1}$	F4	75	$\lvert x \rvert \le 2000$ (-9999)
`var_u_drift`	estimated variance of the zonal ion drift component at each level in profile	$m^2\ s^{-2}$	F4	75	$0 \le x \le 10^6$ $(-9 \cdot 10^6)$

Table 5, Vector Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
v_drift	meridional component of the ion drift velocity at each level in profile	$m\ s^{-1}$	F4	75	$\|x\| \le 2000$ (-9999)
var_v_drift	estimated variance of the meridional ion drift component 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	$\|x\| \le 3000$ (-9999)
var_t_ion	estimated variance of the inverted 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	$\|x\| \le 10^7$ ($-9 \cdot 10^7$)
var_back1	estimated variance of the 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	$\|x\| \le 10^6$ ($-9 \cdot 10^6$)
var_ver2	estimated O_2Atmospheric [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	$\|x\| \le 10^7$ ($-9 \cdot 10^7$)
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(^{1}S)] volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\|x\| \le 10^4$ ($-9 \cdot 10^4$)
var_ver3	estimated OI 557.7 nm [O(^{1}S)] 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	$\|x\| \le 10^7$ ($-9 \cdot 10^7$)
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(^{1}D)] volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\|x\| \le 10^4$ ($-9 \cdot 10^4$)
var_ver4	estimated OI 630.0 nm [O(^{1}D)] 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	$\|x\| \le 10^7$ ($-9 \cdot 10^7$)
var_back4	estimated variance of the inverted line of sight 630 nm background at each level in profile	$(R/cm^{-1})^2$	F4	75	$0 \le x \le 10^{14}$ ($-9 \cdot 10^{14}$)

Table 5, Vector Record Contents

short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
`ver5`	estimated volume emission rate at each level in profile	photons $cm^{-3}s^{-1}$	F4	75	$\|x\| \le 10^4$ $(-9{\cdot}10^4)$
`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	$\|x\| \le 10^7$ $(-9{\cdot}10^7)$
`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	$\|x\| \le 10^4$ $(-9{\cdot}10^4)$
`var_ver6`	estimated OH Meinel (9-4) P1(2) volume emission rate variance at each level	$(photons\ cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^8$ $(-9{\cdot}10^8)$
`back6`	inverted line of sight background at 780 nm	R/cm^{-1}	F4	75	$\|x\| \le 10^7$ $(-9{\cdot}10^7)$
`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	$\|x\| \le 10^3$ $(-9{\cdot}10^3)$
`var_ver7`	estimated OII 732.0 nm $[O^+(^2P)]$ volume emission rate variance at each level	$(photons\ cm^{-3}s^{-1})^2$	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	$\|x\| \le 10^7$ $(-9{\cdot}10^7)$
`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	$\|x\| \le 10^4$ $(-9{\cdot}10^4)$
`var_ver8`	estimated OI 844.6 nm $[O\ (^3S \rightarrow {}^3P)]$ triplet volume emission rate variance at each level	$(photons\ cm^{-3}s^{-1})^2$	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	$\|x\| \le 10^7$ $(-9{\cdot}10^7)$
`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	$\|x\| \le 10^4$ $(-9{\cdot}10^4)$
`var_ver9`	estimated NaD doublet volume emission rate variance at each level	$(photons\ cm^{-3}s^{-1})^2$	F4	75	$0 \le x \le 10^8$ $(-9{\cdot}10^8)$

Table 5, Vector Record Contents					
short name	*Description*	*units*	*type*	*dim.*	*range (missing)*
`back9`	inverted line of sight background at 589 nm	R/cm^{-1}	F4	75	$\|x\| \le 10^{7}$ $(-9{\cdot}10^{7})$
`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	$\|x\| \le 10^{15}$ $(-9{\cdot}10^{15})$
`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	$\|x\| \le 10^{16}$ $(-9{\cdot}10^{16})$
`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	$\|x\| \le 10^{16}$ $(-9{\cdot}10^{16})$
`var_o3pdensity`	estimated O^3P density variance	$(cm^{-3})^2$	F4	75	$0 \le x \le 10^{16}$ $(-9{\cdot}10^{16})$
`chi_square`	*Unimplemented* estimated value of χ^2 for the fit	—	F4	1	$0 \le x \le 10^{6}$ $(-9{\cdot}10^{6})$
Notes: 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					

3.2.3. Processing Status Bitmap, the p_status variable

The p_status variable is a bitmap that records the errors that occur in processing a profile 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. Table 6,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 6, Processing Status Bitmap (p_status)		
bit number	*bit mask*	*Description*
0	0001	*unused*
1	0002	*unused*
2	0004	*unused*
3	0008	*unused*
4	0016	*unused*
5	0032	*unused*
6	0064	*unused*

4. Naming Convention

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