University of Michigan
Space Physics Research Laboratory

TIDI Data Processing Software **Vector File Format**	CAGE No. 0TK63 Drawing No. 055-3933D Project TIDI Contract No. NASW-5-5049 Page 1 of 7

REVISION RECORD			
Rev	Description	Date	Approval
E	• Abridged format for HAO/NCAR preliminary "VEC" files	18 Jan 2003	SCS
D	• Add ion drift vector components • Remove references to O band ratio	1 August 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 March 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	
	Initial Release	10 April 2000	

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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

This document describes the format of files produced at HAO/NCAR containing preliminary TIDI wind vector data. To distinguish these files from the official product produced at UM/SPRL, they are referred to as "VEC" files. The format is a shortened version of the UM/SPRL VECTOR files.

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 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.

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	Rev ID	Version of the data product contained in the file
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	**`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
solar_beta_angle	Float	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	Float	The estimated wind variance due to spacecraft attitude uncertainty in m^2s^{-2}
att_h_var	Float	The estimated tangent point altitude variance due to spacecraft attitude uncertainty in km^2

The date created field contains the time that the file was created, expressed in the TIMED standard ASCII format with fraction seconds omitted.

3.2. Data Segment

The data segment includes the retrieval altitude grid specification and the vector data. The 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 3.

Table 3, Retrieval Altitude Grid

short name	Description	units	dim.	range
alt_retrieved	Altitude of each point in retrieval grid	km	75	$0 \le x \le 600$

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 data are stored as a series of parallel arrays. The first dimension of each array is the record dimension. 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 4. 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 dimension column contains the second dimension of each array. 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.

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.

Table 4, Vector Record Contents

short name	Description	units	dim.	range
time	date and time of the measurement	s since epoch[‡]	1	$x > 0$
ms_time	fractional second of the measurement	ms	1	$0 \le x \le 1000$
ut_date	date of measurement, as a string in the form of YYYYdoy		1	"1999001" $\le x \le$ "2999366"
ut_time	universal time of measurement	ms	1	$0 \le x \le$ 86400000
rec_index	count of record in file	—	1	$x \ge 1$

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

Table 4, Vector Record Contents

short name	Description	units	dim.	range
data_ok	True if data is OK, False if data is contaminated			"T" | "F"
lat	geodetic latitude assigned to the profile	deg	1	$-90 \le x \le 90$
lon	east longitude assigned to the profile	deg	1	$0 \le x \le 360$
ref_alt	representative height above the wgs 84 reference ellipsoid at which other ancillary data items are defined	km	1	$0 \le x \le 10000$
lst	local solar time assigned to the profile at position lat, lon and altitude ref_alt	hr	1	$0 \le x \le 24$
sza	solar zenith angle assigned to the profile at position lat, lon and altitude ref_alt	deg	1	$0 \le x \le 180$
lza	lunar zenith angle assigned to the profile at position lat, lon and altitude ref_alt	deg	1	$0 \le x \le 180$
ilat	invariant latitude assigned to the profile at position lat, lon and altitude ref_alt	deg	1	$-90 \le x \le 90$
mlon	magnetic longitude assigned to the profile at position lat, lon and altitude ref_alt	deg	1	$0 \le x \le 360$
track	track angle assigned to the profile, with a value of 360 at the first ascending node within the file	deg	1	$x > 0$
table_id	identifier of the scan table controlling the measurement	—	1	$0 \le x \le 65535$
measure_track	identifies the side of the spacecraft viewed, either warm side or cold side	—	1	"W" | "C"
flight_dir	flight direction			"F" | "B"
ascending	True if spacecraft is on the ascending (northbound) leg			"T" | "F"
in_saa	True if the spacecraft is in the south Atlantic anomaly			"T" | "F"
p_status	processing status value	—	1	
u1	zonal wind at each level in profile, O_2 Atm (0,0) P9	$m\,s^{-1}$	75	$\|x\| \le 2000$
var_u1	estimated variance of the zonal wind at each level in profile, O_2 Atm (0,0) P9	$m^2\,s^{-2}$	75	$0 \le x \le 10^6$
v1	meridional wind at each level in profile, O_2 Atm (0,0) P9	$m\,s^{-1}$	75	$\|x\| \le 2000$
var_v1	estimated variance of the meridional wind at each level in profile, O_2 Atm (0,0) P9	$m^2\,s^{-2}$	75	$0 \le x \le 10^6$

Table 4, Vector Record Contents

short name	Description	units	dim.	range
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			

4. Naming Convention

The HAO/NCAR "VEC" files use the following name format:

TIDI_VEC_yyyyddd_vv_rr.ncdf

where yyyy is the year, ddd is the day of year, vv is the version number, and rr is the revision number.