IONOSPHERIC DIGITAL DATABASE

WORLDWIDE VERTICAL INCIDENCE PARAMETERS

CD-ROM DATASET

User Documentation Manual

July 1994 ❖ Release 1.0

In Cooperation with the World Data Centers

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CONTENTS

INTRODUCTION

The Ionosphere

The ionosphere is that part of the upper atmosphere where free electrons occur in sufficient density to have an appreciable influence on the propagation of radio frequency electromagnetic waves. This ionization depends primarily on the Sun and its activity. Ionospheric structures and peak densities in the ionosphere vary greatly with time (sunspot cycle, seasonally, and diurnally), with geographical location (polar regions, auroral zones, mid latitudes, and equatorial regions), and with certain solar-related ionospheric disturbances.

The major part of the ionization is produced by solar X-ray and ultraviolet radiation and by corpuscular radiation from the Sun. The most noticeable effect is seen as the Earth rotates with respect to the Sun; ionization increases in the sunlit hemisphere and decreases on the shadowed side. Although the Sun is the largest contributor toward the ionization, cosmic rays also make a small contribution. Any atmospheric disturbance affects the distribution of the ionization.

The ionosphere is a dynamic system controlled by many parameters including acoustic motions of the atmosphere, electromagnetic emissions, and variations in the geomagnetic field. Because of its extreme sensitivity to atmospheric changes, the ionosphere can be used as a sensitive monitor of atmospheric events.

Definitions of the Ionospheric Regions

The ionosphere is divided into four broad regions called D, E, F, and topside. These regions may be further divided into several regularly occurring layers, such as F_1 or F_2.

D Region: The region between about 75 and 95km above the Earth in which the (relatively weak) ionization is mainly responsible for absorption of high-frequency radio waves.

E Region: The region between about 95 and 150km above the Earth that marks the height of the regular daytime E layer. Other subdivisions isolating separate layers of irregular occurrence within this region are also labeled with an E prefix, such as the thick layer, E_2, and a highly variable thin layer, Sporadic E. Ions in this region are mainly O_2^+.

F Region: The region above about 150km in which the important reflecting layer, F_2, is found. Other layers within this region are also described using the prefix F, such as a temperate-latitude regular stratification, F_1, and a low-latitude, semi-regular stratification, $F_{1.5}$. Ions in the lower part of the F layer are mainly NO^+ and are predominantly O^+ in the upper part. The F layer is the region of primary interest for radio communications.

Topside: This part of the ionosphere starts at the height of the maximum density of the F_2 layer of the ionosphere and extends upward with decreasing density to a transition height where O^+ ions become less numerous than H^+ and He^+ ions. The transition height varies but seldom drops below 500km at night or 800km in the daytime, although it may lie above 1000km. Above the transition height, the weak ionization has little influence on transionospheric radio signals.

History of Vertical Incidence Soundings

Sounding of the ionosphere began in 1925. By 1947, an instrument known as the ionosonde was routinely used to measure automatically the characteristics of the ionosphere. During the International Geophysical Year (IGY) of 1957-1958, an international cooperative effort created a worldwide network of ionosondes to record vertical incidence measurements for the 1957-1959 period of maximum solar activity.

The IGY ionosonde was a relatively simple, robust, inexpensive piece of equipment by today's standards. Several countries built IGY ionosondes with few differences among them and thus provided similar worldwide photographic records called ionograms.

Since the IGY, a loosely coordinated worldwide network of vertical incidence ionosondes, varying between 100 and 200 sites, has operated continuously.

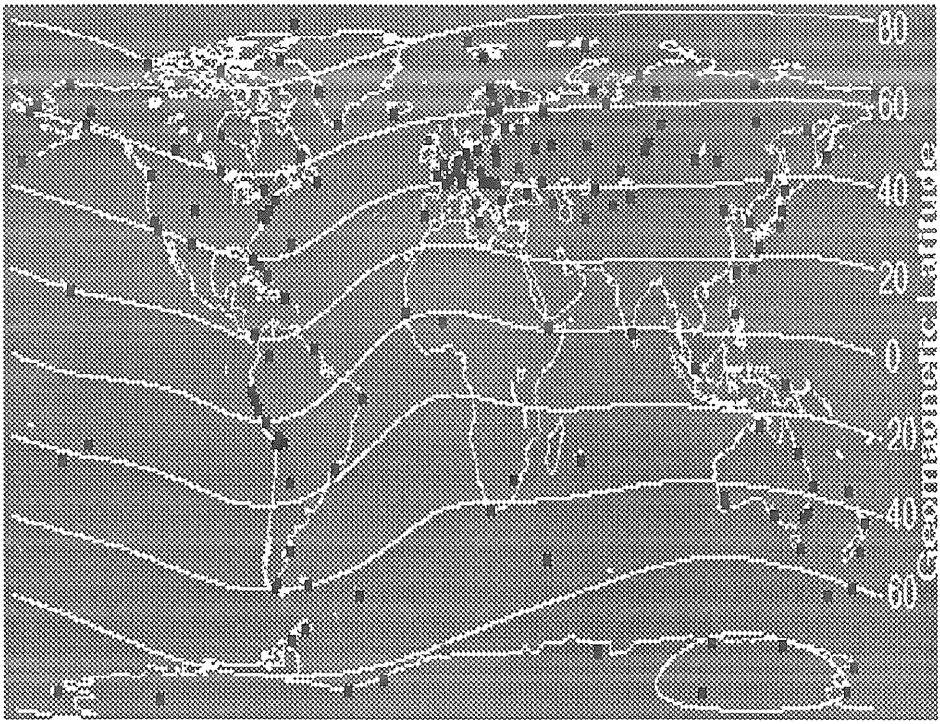
Ionograms

Ionograms are recorded tracings of reflected high frequency radio pulses generated by an ionosonde. Unique relationships exist between the sounding frequency and the ionization densities which can reflect it. As the sounder sweeps from lower to higher frequencies, the signal rises above the noise of commercial radio sources and records the return signal reflected from the different layers of the ionosphere.

These echoes form characteristic patterns or "traces" that comprise the ionogram. Radio pulses travel more slowly within the ionosphere than in free space, therefore, the apparent or "virtual" height is recorded instead of a true height. For frequencies approaching the level of maximum plasma frequency in a layer, the virtual height tends to infinity, because the pulse must travel a finite distance at effectively zero speed. The frequencies at which this occurs are called critical frequencies.

Characteristic values of virtual heights (designated h'E, h'F, and h'F_2, etc.) and critical frequencies (designated foE, foF_1, and foF_2, etc.) of each layer are scaled, manually or by computer, from these ionograms. Typically, an ionosonde station obtains one ionogram recording every 15 minutes. When the scaling is done manually, only the hourly recordings are routinely reduced to numerical data (parameters). Modern ionosondes with computer-driven automatic scaling procedures routinely scale all the ionograms recorded.

The resulting numerical values, along with the original ionograms and station reports, are archived at the five World Data Centers (WDCs) for Ionosphere. These are: WDC-A for STP (USA), WDC-B2 (former USSR), WDC-C1 for STP (UK), WDC-C2 for Ionosphere (Japan), and WDC-D for Astronomy (China). The National Geophysical Data Center (NGDC) is co-located with the World Data Center-A for Solar-Terrestrial Physics.



Ionospheric Stations with Digitized Data on the CD-ROM

CHAPTER 1: WHAT'S INCLUDED

The Ionospheric Digital Database includes the following:

Two compact discs (CDs)
Floppy diskette
User Documentation Manual

The READ.ME file includes details pertaining to software files needed to support the full functioning of this program. Please refer to Chapter 3 "Getting Started" or the READ.ME file on the floppy diskette before executing any program.

Compact Discs

The Ionospheric Digital Database compact discs contain approximately 40,000 station years (1.35 gigabytes) of scaled digital vertical incidence parameters from about 130 sites around the world. These data have been contributed through a major cooperative effort among the World Data Centers and many ionosonde network organizations (see Contributor List).

The Compact Disc-Read Only Memory (CD-ROM) media have been written in the International Organization for Standardization (ISO) 9660 format.

These CD-ROMs, or CDs as they are called here, contain only data. Custom-designed software, catalogs, and documentation are included on the floppy diskette. All data are ASCII and easily accessible with user-designed software.

Even though these CDs are quite hardy, care should be used in handling and storing them. Dust, scratches, ink, paint, and fingerprints may obscure data. Given careful handling, a ten-year life span can be expected.

Floppy Diskette

The Ionospheric Digtial Database (IDD) access and display software has been designed to be intuitive and easy to use. Its two primary purposes are to provide a means of obtaining a graphical "quick-look" at the data and to support data retrieval from the CD. User instructions for the software are in Chapter 4. Instructions and navigation commands are also provided "on-line" as context-sensitive HELP windows inside the IDD display software.

Software Files

The files necessary to run the IDD software are packed into a self-extracting file called IONO_CD. This information is also included in the READ.ME file on the floppy diskette. The following files are needed to support full functioning of the access and display software:

IDD.EXE	IONCAT.IWG
MENU.DAT	STATION.LST
SETUP.DAT	C5081.PCX
CDHELP.HLP	SUN.PCX

The IWGSTRIP.EXE utility file that strips parameter data from the .IWG data files in a tabular format along with how-to details supplied in the IWGSTRIP.DOC file are also included on the floppy diskette.

CHAPTER 2: DATA COLLECTION

Quality Control

The ionospheric vertical incidence data compiled for this database have been sent to NGDC in many differing formats. These data have been inspected for errors and passed through quality control filters to discern and correct, whenever possible, any errors in order to bring the data to the highest possible level of correctness before being archived and made available to users.

In November 1993, the Ionospheric Informatic Working Group (IIWG) format was adopted. See Chapter 5 for a detailed description of this data format. The IIWG format allows data to contain higher than hourly time resolution. Most of the data on the CDs is in standard resolution (hourly), but some higher time resolution data from digital sounders with automatic scaling have been included.

All the data placed on this CD database come from 1957 through 1990 and have been digitized, reformatted, and converted to Universal Time. However, data which have not yet reached this level of processing or fall outside this time span may be available through NGDC. Data are being processed and added to our database as quickly as possible after they are received at NGDC.

Monthly Medians

Monthly statistics (medians, counts, and other derivatives) were recalculated and added to the database at NGDC. A full description of how the International Union of Radio Science (URSI) intended monthly medians to be calculated is given in UAG-23. Because this explanation has been easily misinterpreted, it has not been possible to keep track of the method of calculation used for monthly medians by all the different sources from which NGDC has gathered data. Since the method NGDC uses to calculate the monthly medians can be defined without ambiguity, it is hoped that it will satisfy most users.

The NGDC median calculation method used for the Ionospheric Digital Database uses only full weight values (no qualifiers) to pick the middle value when the numbers are arranged in order of magnitude. A monthly median is calculated only if ten or more values exist for the hour.

Future Updates

Corrections, data to fill existing gaps, and data from before and after the 1957 through 1990 period of this release will be added to this continuing database. These data can be obtained from NGDC and will be issued on CDs in the future.

Updates to the access software will be provided on diskette coded by version release number. When using NGDC updated releases of the access and display software, data corrections and updates should be automatically incorporated.

Preliminary release CDs and software sent to several experienced users for testing are not compatible with this version (Release 1.0, July 1994).

CD Directory Structure

Each file is named with the International Union of Radio Science (URSI) three digit computer code followed by the year and an .IWG extension. All the data for that station for that year are included in the file. Each file is included in a subdirectory named by year. IONO-1-CD contains 1957 through 1975 and IONO-2-CD contains 1976 through 1990. Data on this CD dataset are in IIWG format as ASCII files. (See Chapter 5 for IIWG format description.)

CHAPTER 3: GETTING STARTED

Setting Up Your Computer

If you have questions about setting up your CD drive, refer to the manual that came with it to find out how to set up your computer and CD reader to provide the necessary CD-ROM environment. If you have more than one CD reader, configure your system to accommodate both of CDs in this package according to your CD drive manual instructions.

The access and display software provided with this CD dataset was designed to operate on any IBM 286 or higher personal computer or compatible PC with an EGA or higher graphics board and a CD-ROM reader. The software will operate on a monochrome monitor, but highlighting and color coding will be adversely affected. When the video card is EGA or below, the opening screens will be skipped and the main menu grid appears. As with any software, response time will be determined by the speed of the computer. This software is PC-based and is not designed to operate on other platforms.

The Ionospheric Digital Database (IDD) software requires about 2.0 megabytes of disk space and 450 kilobytes of DOS conventional memory to run properly. In order to free up memory, you may need to modify the CONFIG.SYS and AUTOEXEC.BAT files while running IDD. Be sure to reboot your PC for these changes to take effect before running the Ionospheric Digital Database software.

Loading Access and Display Software

The READ.ME file includes details pertaining to software files needed to support the full functioning of this program. Please refer to the details below or the READ.ME file on the floppy diskette before executing any program.

The IDD access and display software is provided on a high-density (1.44 megabyte) 3.5 inch diskette. High-density (1.2 megabyte) 5.25 inch floppy diskette or other media can be provided upon request.

When your system has been configured for the necessary memory and disk space, follow the installation instructions outlined below:

1. Insert the software diskette into the diskette drive "A" (or drive "B") and change to the drive and directory from which you wish to operate the software.

2. Type A:IONO-CD (or B:IONO-CD). Press Enter key.

3. Place one of the CDs (lettering side up) into the CD reader unit.

4. Now you are ready to execute the Ionospheric Digital Database software. Go into the directory that contains IDD.EXE and at the DOS prompt type the command IDD and press Enter. IDD can also run from a DOS shell inside MicroSoft Windows or Windows NT, provided sufficient memory is available.

5. When you first run IDD you will need to specify the CD reader drive letter by selecting SETUP from the MAIN MENU and choosing CD SETUP. Specify a second drive letter, if you have more than one CD reader configured in your system.

For Additional Help

The Ionospheric Digital Database software will be periodically updated. You should reference all inquiries to the specific release number. This version is Release 1.0, July 1994.

If you have any comments, corrections, or questions concerning the Ionospheric Digital Database or the IDD custom software, please contact:

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CHAPTER 4: USER INSTRUCTIONS

Introduction

The software for the Ionospheric Digital Database is intended to be intuitive enough to prompt the user through the selection process.

For detailed instructions press the F1 key in any screen to invoke the on-line, context-sensitive HELP.

With the Ionospheric Digital Database software, you may browse and display any data in IIWG format on the CD database or elsewhere in your system. In the individual mode a graph of the diurnal distribution for up to one month is displayed along with the monthly median values. Comparative or composite modes display up to six datasets of any combination of station, date, and ionospheric parameter data available. The browse mode allows the user to search through the numerical values in any one of the selected datasets.

The graphs that you create can be stored as PCX files to disk for display at a later time or for creating your own series of computerized images for visual reproduction.

A world map with both Geographic Longitudes and Latitudes as well as corrected Geomagnetic Latitudes displays the catalog of all ionosonde stations and stations with digital data contained on the CD database. The catalog of digital stations may be searched by any geographic area, date, or ionospheric parameter to ascertain availability of data.

Before you begin, you may want to take a moment to examine the following list of keyboard and mouse protocols. To use a mouse, the mouse drivers must be installed before IDD is run.

F1	Views context-sensitive HELP screens.
Arrow Keys	Scroll through and highlight items within a menu field.

Tab/Shift-Tab	Moves among and highlights items within a menu field.
PageUp/Down	Moves among and highlights items within a menu field.
Home/End	Moves among and highlights items within a menu field.
Enter	Selects highlighted item.
Escape	Returns to the next higher-level menu.
Mouse	Clicking the left mouse button on an item highlights that option. Double clicking activates that menu option. Clicking anywhere outside a menu option exits that menu and returns to the prior menu.

Learning the IDD Software Menu

Once the parts of your system are communicating properly and the Ionospheric Digital Database (IDD) software has been installed (according to the instructions in Chapter 3), type the command IDD at the DOS prompt, and then press Enter.

The program title screen prompts you to WAIT while the program initializes itself and then you will be asked to PRESS ANY KEY TO CONTINUE. (If you have an EGA or below video adapter, see "Setting Up Your Computer" in Chapter 3.)

The Ionospheric Digital Database software has a series of on-screen "menus" which allow you to choose among the available options as you use the software. The highlighted item will be selected if you press Enter.

Typically, when a menu appears on the screen, the first item is highlighted. Thus, when MAIN MENU appears on the screen, the first item, CATALOG, appears highlighted. Highlighted letters within items on the menu bars will invoke the options for that item when you press the corresponding keyboard letter.

Menu items are listed in the logical order to proceed for selection. Data must be selected before they can be displayed in a graphical format or browsed as a numerical table. Valid days for a month can be indicated only after the month is selected. Parameter selection is based upon station and date selection. Proceed through sequences in the order listed; the highlighted item will usually be the best place to start. To exit any procedure press ESC.

Menu lists contain highlighted letters and numbers that, when the corresponding key is pressed, will highlight the first occurrence of that letter or number in the list.

Menu Overview

MAIN MENU

The Ionospheric Digital Database software first screen is the MAIN MENU containing the following submenus: CATALOG, DATASET, DISPLAY, SETUP, HELP, ABOUT, and QUIT. Each of these will be described briefly. Beneath the MAIN MENU box is the Dataset Selection grid where up to six sets of data may be entered by station, date, and ionospheric parameter.

CATALOG

A world map with both Geographic Latitudes and Longitudes as well as corrected Geomagnetic Latitudes computed from the PACE model [K.Baker, 1986] is displayed when CATALOG is selected. The map is color coded to distinguish between locations of all ionosonde stations known to have operated and stations having digital data on the IDD CD database.

All the digitized data from 1957 through 1990 that have been placed on these CDs will show in the CATALOG display. The catalog of digital stations may be searched by any geographic area, data, or ionospheric parameter to ascertain availability of data.

Text at the top of the world map indicates that a selection has been made for any combination of area, date, and parameter. A list of the stations containing digital data for the selection can be saved to a file. The map may be saved as a PCX file.

DATASET

A dataset refers to one month (or any part of a month) of one ionospheric parameter for one station.

The options under DATASET allow the user to SELECT a dataset, REMOVE a selected dataset from the grid, SAVE a dataset to a file, or COPY FILES to disk (IIWG station-year files).

Under SELECT, choose between CATALOGED (data on this CD dataset) or NON-CATALOGED data (elsewhere in your system). A Load Non-Cataloged Data Dialog box guides you to select the location of non-cataloged data for use in the Select Dataset grid. The non-cataloged data must be in standard IIWG format; data on this CD dataset are in IIWG format as ASCII files. (See Chapter 5 for IIWG format description.)

To select a dataset, invoke STATION from the submenu bar and scroll through the list to highlight the desired station name. Press Enter to send the station name to the selection grid.

Next select the DATE submenu. Only dates valid for the station named are listed in the Date Dialog box. The user selects the year, then month, and then days desired from the Begin and End columns. To implement your selections execute the Accept field. Lists are sensitive to the previous selection.

PARAMETER lists only those ionospheric characteristics available for the station and dates selected. Enter the desired parameter onto the selection grid.

LOCATE searches the location previously specified in CD SETUP (under SETUP on the MAIN MENU bar) and enters the station, date, and parameter onto the Select Dataset grid. If the data are found and entered, the program will put you back at the SELECT option for continuing to select datasets if desired. If the wrong CD is mounted, a message tells the user that the data cannot be located. Switch CDs and try again. Data are placed on the CDs by year. If the data cannot be located, check the CD SETUP to be sure the correct drive where the data are located has been specified.

NO DATA SELECTED is the label for the next available slot in the Select Dataset box. Stations previously selected are numbered and listed in this box.

When further selections are to be made it may be useful to retain station, date, and parameter selections in the grid, for example, when only minor changes are being made. However, a change to a station for which the previously selected date or parameter is not available will evoke a message explaining that no data are available for that parameter or date. The grid field may be emptied of selections with the CLEAR option.

IDD allows the user to export (SAVE) a selected dataset (one month of one parameter for one station) or a file (COPY FILE) (all the data for one station for one year). For the user's convenience, IWGSTRIP.EXE is included with this software to allow more versatility in extracting data. Read the IWGSTRIP.DOC file.

This version of IDD displays only hourly values. However, an asterisk (*) will appear by the dataset number on the grid when the database contains data with higher than hourly time resolution. Any file the user saves will contain the time resolution of the original data.

DISPLAY

All the selected datasets may be displayed in three graphical modes, INDIVIDUAL, COMPARATIVE, COMPOSITE, and in one tabular mode, BROWSE. Each of these options may be selected in either UNIVERSAL (UT) or Local Meridian (LMT) Time.

INDIVIDUAL displays a graph of the diurnal distribution for up to 31 days, labeled by station name, year, month, and parameter as well as maximum scale value, the Geographical Latitude and Longitude, and whether in UT or LMT. This display also shows the monthly median values, if available, overlayed on each day. (For information about how NGDC calculates monthly medians, see Chapter 2.)

COMPARATIVE displays two to six graphs in rows one above the other. Maximum scale value and UT or LMT are indicated. Each graph is labeled on the left with station name, parameter, and month/year. Use arrow keys to bring days into view on the graph that are not visible on the screen.

COMPOSITE creates a graph with two to six datasets overlayed on each other. Different colored lines are plotted on top of the first dataset. To the left are station name, parameter, and month/year labels coordinated by color. Maximum scale value and UT or LMT are also indicated. Although the "please wait" message may disappear, continue to wait until all datasets selected are plotted on the composite graph.

The BROWSE option allows you to search through a table of the data by hour and day in any one of the selected datasets. Scroll through the data using arrows shown, mouse, or keyboard commands. Station name, parameter, month/year, and UT or LMT are indicated.

SETUP

IDD defaults to VGA (or EGA if VGA or above is not detected). SETUP allows the user to designate a different video graphics adapter specification and the data drive letter(s).

HELP

You can instantly call up brief explanations of the IDD menu options by pressing the F1 key in any screen to invoke context-sensitive HELP for that menu option or dialog box.

ABOUT

The program version number of the software is displayed in the ABOUT option. Release 1.0, July 1994, was designed by Ray Conkright, National Geophysical Data Center, and written by Zirkle Wells Software Group, Inc., Boulder, Colorado. The User Documentation Manual was created by Karen Fay O'Loughlin, National Geophysical Data Center.

QUIT

QUIT is used to exit the program. Escape will cancel the QUIT PROGRAM command.

CHAPTER 5: IIWG DATA FORMATS

IIWG Data Exchange Format

The International Union of Radio Science (URSI) Ionospheric Informatic Working Group (IIWG) has produced a data exchange format to address problems such as scaled time resolutions greater than the traditional hour-based usage found in previously accepted formats. For a full description of the data format and the philosophy behind its creation see "Ionogram Characteristics at Uneven Data Rates," by Gamache and Reinisch [1989].

The IDD software can access data only in the IIWG format. This format allows data from all sampling rates to be included in the database. Even though most of the data on these CDs contain only hourly values, data taken on autoscaling equipment produce fully scaled data for every ionogram. Most future data will come from equipment which automatically scales the ionograms. The IIWG format allows the archiving of all data regardless of the resolution.

IIWG Format Description

Data Group 1: Station headers (informative and encoding data)		
FORTRAN RECORD #	FORMAT	DESCRIPTION
1	A30	Station name
1	A5	Station code
1	I4	Meridian time used by station (in degrees)
1	F5.1	Latitude +North, -South
1	F5.1	Longitude, East
1	A10	Scaling type: Manual/Automatic
1	A10	Data editing: Edited/Non-edited/Mixed
1	A30	Ionosonde system name

Data Group 2: Data headers (measurement times for the month)		
FORTRAN RECORD #	FORMAT	DESCRIPTION
2,3	30I4*	Year
2,3	30I4*	Month
2,3	30I4*	Number of days in the month, M
2,3	30I4*	Number of Parameters
2,3	30I4*	Numbers of measurements total
2,3	30I4*	Numbers of measurements for each of the M days, NM
4,i	12A10*	List of parameters
i+1,j	12A10*	Dimensions
j+1,k	60A2*	List of corresponding URSI codes
Data Group 3: The data (actual values of the parameters and the corresponding hourly medians and statistics)		
FORTRAN RECORD #	FORMAT	DESCRIPTION
k+1,l	20(3I2)*	The NM sample times Hh:Mm:Ss (repeated for each of the M days)
l+1,m	24(I3,2A1)*	The N1 values of characteristic 1 for day 1 (repeated for each of the M days)
m+1	24(I3,2A1)	Hourly Medians for characteristic 1
m+2	24(I2,2A1)	The counts for the hourly medians, Range
m+3	24(I3,2A1)	Upper quartile
m+4	24(I3,2A1)	Lower quartile
m+5	24(I3,2A1)	Upper decile
m+6	24(I3,2A1)	Lower decile
m+7,n	24(I3,2A1)*	The N2 values of characteristic 2 for day 1 (and so on, repeated for each characteristic)
* Format is repeated as many times as necessary to read/write the data.		

URSI Qualifying and Descriptive Letters

Parameter Coding by International Union of Radio Science (URSI)

Five positions are reserved for scaled values: 3 numeric for the value, 1 alpha for qualifier, and 1 alpha for descriptor. Valid combinations are: a full weight value (123__), an unqualified, but described value (123_A), a qualified and described value (123UA), or a replaced value(____A).

QUALIFICATION Letters

A	less than (used only fbEs in case of total blanketing).
D	greater than.
E	less than.
I	interpolated.
J	deduced from x component.
M	mode uncertain.
T	smoothed from sequence.
U	uncertain.
Z	deduced from z component.

DESCRIPTIVE Letters

A	blanketing.
B	absorption.
C	non-ionospheric (equipment).
D	above upper frequency range of equipment.
E	below lower frequency range of equipment.
F	frequency spread.
G	ionization density too small.
H	stratification.
K	particle E layer.
L	no sufficiently defined cusp between F layers.
M	mode uncertain.
N	superimposed layers.
O	measurement refers to o component.
P	man-made perturbation of parameters.
Q	range spread.

R	attenuation near critical frequency.
S	interference.
T	interpolated.
V	forked trace.
W	above height range.
X	measurement refers to x component.
Y	lacuna (tilt).
Z	measurement refers to z component.

When qualifier and descriptive letters are not used with the data, it must be clear that their absence does not indicate full weight values. The IIWG has developed a code to designate this condition properly, as indicated in the table below:

Scaling Method	Editing	QD entry
Manual	Edited (QD entered)	"QD"
	Edited (no QD entered)	"/ "
Automatic	Edited (no QD entered)	"/ "
	Non-edited (no QD entered)	"// "

Note QD = Qualification and Descriptive Letters

For more details on qualification and description letters, see W.R. Piggott and K. Rawer, editors, URSI Handbook of Ionogram Interpretation and Reduction, 2nd edition (Report UAG-23, World Data Center A for Solar-Terrestrial Physics, Boulder, CO, 1972).

Ionospheric Vertical Incidence Parameters

F Layer Parameters

Parameter	URSI code #	Dimension	Description
foF_2	00	.1 MHz	F_2 layer o-mode (ordinary) critical frequency
fxF_2	01	.1 MHz	F_2 layer x-mode (extraordinary) critical frequency
fzF_2	02	.1 MHz	F_2 layer z-mode critical frequency
$M3000F_2$	03	.01 MHz	F_2 layer M factor (the ratio of the maximum usable frequency divided by the critical frequency)
$h'F_2$	04	km	F_2 layer o-mode minimum virtual height
hpF_2	05	km	An estimate of the true height of the F_2 layer (measurement of the ordinary mode virtual height at a frequency of 83.4% of foF_2)
h'Ox	06	km	F layer minimum virtual height of the x-mode trace at a frequency equal to the foF_2
MUF3000 F_2	07	.1 MHz	F_2 layer maximum usable frequency for a 3000km path
hc	08	km	The height of the maximum obtained by fitting a theoretical h'F curve for the parabola of best fit to the observed ordinary mode trace near foF_2 and correcting for underlying ionization
qc	09	km	F layer scale height
foF_1	10	.01 MHz	F_1 layer o-mode critical frequency
fxF_1	11	.01 MHz	F_1 layer x-mode critical frequency
$M3000F_1$	13	.01 MHz	F_1 layer M factor (see URSI code 03)
$h'F_1$	14	km	F_1 layer o-mode minimum virtual height

h'F	16	km	F layer o-mode minimum virtual height
MUF3000 F_1	17	.1 MHz	F_1 layer maximum usable frequency (see URSI code 07)

E Layer Parameters

Parameter	URSI code #	Dimension	Description
foE	20	.01 MHz	E layer o-mode critical frequency
foE_2	22	.01 MHz	E_2 layer o-mode critical frequency (when it occurs it is between the normal E and F_1 layers)
h'E	24	km	E layer o-mode minimum virtual height
$h'E_2$	26	km	E_2 layer o-mode minimum virtual height

Es Layer Parameters

Parameter	URSI code #	Dimension	Description
foEs	30	.1 MHz	Es layer highest o-mode frequency at which a mainly continuous Es trace is observed
fxE	31	.1 MHz	Es layer highest x-mode frequency at which a mainly continuous Es trace is observed
fbEs	32	.1 MHz	The blanketing frequency of layer used to derive foEs
ftEs	33	.1 MHz	Top frequency of the Es trace (any mode)
h'Es	34	km	The minimum virtual height of the layer used to derive foEs
Type Es	36		A characterization of the shape of the Es trace

Other Parameters

Parameter	URSI code #	Dimension	Description
$foF_{1.5}$	40	.01 MHz	The o-mode critical frequency of the $F_{1.5}$ intermediate stratification (between F_1 and F_2)
fmin	42	.1 MHz	The lowest frequency at which an o-mode echo is observed on the ionogram
M3000 $F_{1.5}$	43	.01 MHz	$F_{1.5}$ layer M factor (see URSI code 03)
$h'F_{1.5}$	44	km	$F_{1.5}$ layer o-mode minimum virtual height
fm_2	47	.1 MHz	The fmin for the second order o-mode trace
hm	48	km	The height of the maximum electron density of the F_2 layer calculated by the Titheridge method
fm3	49	.1 MHz	The fmin for the third order o-mode trace

Spread E/Oblique Parameters

Parameter	URSI code #	Dimension	Description
foI	50	.1 MHz	The highest o-mode frequency of spread F
fxI	51	.1 MHz	The highest frequency of spread F traces (any mode)
fmI	52	.1 MHz	The lowest o-mode frequency at which spread traces are observed for the F layer
M3000I	53	.01 MHz	M Factor deduced from upper frequency edge of spread traces and fxI (see URSI code 03)

h'I	54	km	Minimum slant range of the spread F trace
dfs	57	.1 MHz	Frequency range of the spread

N(h) Parameters

Parameter	URSI code #	Dimension	Description
$fh'F_2$	60	.1 MHz	The frequency at which $h'F_2$ is measured
fh'F	61	.1 MHz	The frequency at which h'F is measured
$h'mF_1$	63	km	The maximum virtual height in the o-mode F_1 cusp
h_1	64	km	True height at f_1 Titheridge method
h_2	65	km	True height at f_2 Titheridge method
h_3	66	km	True height at f_3 Titheridge method
h_4	67	km	True height at f_4 Titheridge method
h_5	68	km	True height at f_5 Titheridge method
H	69	km	Effective scale height at hmF_2 Titheridge method

REFERENCE: Definition of Characteristic extracted from UAG23 (URSI Handbook of Ionogram Interpretation and Reduction, November, 1972)

CHAPTER 6: WORLD DATA CENTER SYSTEM

WDC Program Overview

The World Data Center (WDC) system is a dynamic global network of 40 currently active discipline centers linking data contributors to data users. It was created as a voluntary scientific mechanism to assure the safe collection, archival, and efficient dissemination of data and information collected during the International Geophysical Year (IGY: 1957-58). For over 36 years, under International Council of Scientific Unions (ICSU) guidance, the WDC system has operated as a permanent part of the conduct of global science programs.

A continuing WDC operating principle is that data are completely accessible to all scientists in all countries without exception. The concept of a "classified" or "restricted distribution" database is foreign to WDC principles. If data are held by a WDC, they are available, either at no charge or for a minimal charge, to anyone requesting them. If a requester is also a source of data, they are entitled to a roughly equivalent amount of data in exchange without charge.

The WDC system, especially through NOAA, has been a leader in adapting the new capabilities of optical disc media known as Compact Disc-Read Only Media (CD-ROM) to modern needs.

World Data Center-A for STP

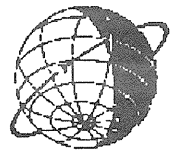
The World Data Center-A for Solar-Terrestrial Physics (WDC-A for STP) is the focal point for data pertaining to solar activity, the ionosphere, and geomagnetic variations. The National Geophysical Data Center (NGDC), which is co-located with WDC-A for STP, collects, archives, and disseminates data from seven interrelated Solar-Terrestrial Physics disciplines: Solar and Interplanetary Phenomena, Ionospheric Phenomena, Flare-Associated Events, Geomagnetic Variations, Aurora, Cosmic Rays, and Airglow.

Aside from the many aspects of purely scientific research, numerous environmental influences are caused by the Sun. Beyond the obvious considerations of heat and light, examples of direct and indirect solar influences are the effects on radio communications, navigation systems, satellites, hazards to humans and technical systems, geologic exploration, electrical power transmission, pipelines, climate and global change, weather, and biological systems.

Of interest here are data related to the ionosphere. NGDC has assembled some 40,000 station-months of scaled digital ionospheric vertical incidence parameters from about 130 sites worldwide and presents them on this CD database for general distribution.

For information about the collection and international exchange of ionospheric data, see International Council of Scientific Unions, Panel on World Data Centres (Geophysical and Solar), GUIDE to the WORLD DATA CENTER SYSTEM, Part 2: IONOSPHERE (World Data Center A for Solar-Terrestrial Physics, Boulder, CO, 1989).

The five World Data Centers (WDCs) for Ionosphere are: WDC-A for STP (USA), WDC-B2 (former USSR), WDC-C1 for STP (UK), WDC-C2 for Ionosphere (Japan), and WDC-D for Astronomy (China).



Contributing Agencies

The data for the Ionospheric Digital Database Worldwide Vertical Incidence Parameters have been contributed through a major effort among the World Data Centers and many ionosonde network organizations. Global coverage in scientific arenas is only possible with this kind of international cooperation.

We gratefully acknowledge the following major contributors:

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We acknowledge with appreciation the following contributors and any others we may have inadvertently omitted.

Centro de Estudos de Radio Propagacao
Escola Politexnica
Sao Paulo BRAZIL

Danish Meteorological Institute
Copenhagen DENMARK

Geophysical Institute
Bulgarian Academy of Sciences
Sofia BULGARIA

Geophysical Institute, Department of the Ionosphere
Czechoslovak Republic Academy of Sciences
Praha (former) CZECHOSLOVAKIA

Geophysical Observatory, Ionospheric Station
Finnish Academy of Sciences and Letters
Sodankyla FINLAND

Geophysical Observatory
Christchurch NEW ZEALAND

Institute of Geodesy and Geophysics
Sopron HUNGARY

Institut Royale Meteorologique de Belgique
Bruxelles BELGIUM

Institute of Telecommunications
Warsaw POLAND

Instituto Geofisico del Peru
Observatorio de Huancayo
Huancayo, Lima PERU

Instituto Nazinale di Geofisica
Osservatorio Geofisico Centrale
Rome ITALY

Ionospharen Institut
Breisach/Rhein (former) GERMAN FEDERAL REPUBLIC

Kiruna Geophysical Institute
Kiruna SWEDEN

Laboratorio Ionosfisico Armada Republica Argentina (LIARA)
Buenos Aries ARGENTINA

Laboratorio de Ionosfera
Instituto de Fisica
Tucuman ARGENTINA

Library of National Meteorological Service
Budapest HUNGARY

Manila Observatory
Manila REPUBLIC OF THE PHILIPPINES

Massachusetts Institute of Technology
Lincoln Laboratory
Lexington, Massachusetts USA

Max-Plank Institut fur Aeronomie
Lindau/Harz (former) GERMAN FEDERAL REPUBLIC

Propagation Prediction Services
Radio Communications Systems Programme
Pretoria REPUBLIC OF SOUTH AFRICA

Radio Research Laboratory
Ministry of Communications
Seoul REPUBLIC OF KOREA

Royal Netherlands Meteorological Institute (KNMI)
Geophysical Division
De Bilt THE NETHERLANDS

Telecommunications Training Institute
Ministry of Transportation and Communications
Taipei TAIWAN

Universidad de Concepcion
Departmento de Geofisica
Concepcion CHILE

University of Tromso
Institute of Mathematical and Physical Sciences
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Corrections to the Ionospheric Digital Database (1957-1990) 2-CD-ROM set

1. Capetown (CT13M) and Johannesburg (JO12O) appear to be time shifted by 12 hours. For Capetown, the dates are June and August 1988. For Johannesburg, the dates are June - August, and October 1988.

2. Kheysa Island (BT280) data have an incorrect latitude in all 1989 and 1990 header records. Copy the files to your hard drive and then edit each one. Replace '`BT280  0  -4.0 58.0`' with '`BT280  0  80.6 58.0`' in the header.

3. La Reunion (LR22J) data have local time for all of 1989.
* All La Reunion foF1 values should be multiplied by 10 for the correct archive format.

4. Manila (MN414) seems to be time shifted for October 1967, April 1969, and July 1969. For November 30, 1974 the foF2 values for hours 2000 and 2100 are 198 (19.8); these values are incorrect.

5. Ouagadougou (OU012) has several errors. One pertains to the median count values which should have a maximum of two bytes but may have four bytes for the value; use only the last two. The 1985 data are labeled as 1983.

6. Tahiti (TT71P) data have some bad characters that replaced the actual data on August 2 of most years. Consequently, only a partial correction can be made. Tahiti data have local time for all of 1989. The 1971 data are missing several hourly values at the start of each month.
* All Tahiti foF1 should be multiplied by 10 for the correct archive format.

* All station header records show foF1 as a value that should be multiplied by 0.01 MHz. If the value is normally a 3 byte integer, such as '450', the value needs no adjustment. If the foF1 value is usually a two byte integer, such as ' 45', multiply by 0.1 MHz.

Corrected data files will be placed on the ftp anonymous account. Access is obtained by typing the following commands.

TYPE: **ftp ftp.ngdc.noaa.gov**
USER NAME: **anonymous**
PASSWORD: (Your E-Mail address)
TYPE: **cd pub**
(This will move you to directory **pub**)
TYPE: **cd mor**
(This will move you to directory **mor**)

If you do not find directory **mor**, there are no corrected data available. Data that have been quality controlled will be put in this directory, starting June 15, 1996 (1800UT). The directory and files are automatically deleted after about two weeks.

If you do not have access to FTP, let us know and we will send the latest updates to you.

If you detect errors, please let us know what they are. Identify the problem, the station, and the dates. We will try to make corrections and supply all our customers with updates. Send the information to us by FAX, Mail, or E-mail. Our FAX number is 303-497-6513.

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