README Document for

High Resolution Dynamics Limb Sounder (HIRDLS) Level 2 Standard Product:

Temperature, Ozone (O3), Nitric Acid (HNO3), CFC-11 (CF2Cl2), CFC-12 (CFCl3), Cloud Top Pressure, and Aerosol Extinction (at 12.1 microns), and Geopotential Height (GPH)

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Revision History

Revision Date	***Changes***	***Author***
3/18/2010	Initial version	Young-In Won
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1. Introduction

1.1 Brief background

This document applies to the Aura High Resolution Dynamics Limb Sounder (HIRDLS) Level 2 geophysical parameters product produced by collection version 5 (HIRDLS version 5.00.00) of the HIRDLS data processing algorithm. User should download and consult with a copy of HIRDLE data Level 2 **Data Description and Quality Document** (http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/HIRDLS/documents/HIRDLS-V5-DQD.pdf). Please check for the latest version before using the data.

The HIRDLS instrument is designed to scan the Earth limb at multiple azimuth angles, measuring infrared emissions in 21 channels ranging from 6.12 to 17.76 microns in the upper troposphere, stratosphere and mesosphere. These measurements are used to determine the global distribution of temperature and concentrations of O_3, H_2O*, CH_4*, N_2O*, NO_2*, HNO_3, N_2O_5*, CFC11, CFC12, $ClONO_2$*, aerosol extinction, cloud top pressure and geopotential height (*currently not available; these species will be retrieved when an improved algorithm is available). The vertical resolution of the HIRDLS data is about 1 km, and the spatial coverage is near-global (-65 degrees to +80 degrees latitude), with each profile spaced about 100 km along the orbit track.

Due to the launch-induced anomaly, vertical scans can only be made at a single azimuth angle of 47º line of sight (LOS) from the orbital plane, on the side facing away from the sun. This limits the extension of data coverage to 65º S, missing all of Antarctica.

At the current version, data are available from January 22, 2005 until January 1, 2008. HIRDLS stopped acquiring data after March 17, 2008 when the chopper experienced an anomaly. Data from January-March 2008 will eventually be made available.

Table 1. Basic characteristics of the HIRDLS L2 data.

Latitude extent	-65° to 82°N
Longitude extent	-180° to 180°E
Horizontal resolution	500 km (5°)
Vertical resolution	~ 1.5 km
Temporal resolution	~15.5 seconds

1.2 Changes from V4 to V5 and Data Disclaimer

A short description on changes from V4 to V5 that are most visible to the user is given below. Please read this section carefully before reporting problems with data or data availability.

- Geopotential Height (GPH, RawGPH) has been added in Version 5. Also added is OrbitNumber.

- The useful range of Temperature and Ozone data has extended as follows.
  Temperature: 400 – 0.04 hPa (previously 316 – 1hPa)
  Ozone: 260- 0.5 hPa (previously 100 – 1.0 hPa)

- The pressure level has been reduced to 121 (0.02 hPa) from 145 (0.001 hPa) as there have not been (and will likely never) data up to that high level.

- The HIRDLS file naming convention has been slightly modified as follows.
  HIRDLS-Aura_L2_v*_cxx_<yyyy>d<ddd>.he5 : for collection 5 (v5.00.00)
  HIRDLS_v*_cxx_<yyyy>d<ddd>.he5 : for collection 4 (v2.04.19)
  Where:
  - **v* =** algorithm version identifier, made up of major version, minor version, and input data change
  - **cxx =** file cycle number
  - **yyyy** = four digit calendar year
  - **ddd** = day number in the year (001=January 1)
  - **he5** = format of the file (HDF-EOS5)

- HIRDLS Level 2 (L2) data is stored in the HDF-EOS5 format in the HDF-EOS Aura File Format Guidelines document.
  (http://www.eos.ucar.edu/hirdls/HDFEOS_Aura_File_Format_Guidelines.pdf).
  These data files can be read via C/C++ or Fortran using either the HDF-EOS5 or HDF5 library. A HIRDLS developed IDL routine "get_aura" is also available upon request for those users who wish to use IDL to access the HIRDLS data.
  Warning for IDL users: Due to internal changes within the HDF5 library used to create V5 data, IDL must be upgraded to 7.1 in order to read the HIRDLS V5 data.

- Data points for which the majority of the information comes from the a priori have their precision fields set negative and the user should decide whether data are suitable for scientific studies.
  (See http://www.agu.org/journals/jd/jd0920/2009JD011937/ for details on quantitative a priori contributions to the errors. In addition, one may consult the web page http://www.eos.ucar.edu/hirdls/data for details on negative precision.)

- A few cloud tops are not detected, resulting in retrievals at low altitudes of cloud-contaminated radiances. This can result in retrieved temperatures being too warm, and positive or negative spikes in species retrievals.

- While not expected, there may be some residual differences between up and down scans. Critical features should be checked to ensure they appear in scans in both directions.

- Table 1 below details the useful vertical range, and the HIRDLS team contact for each product in this version. The vertical range and accuracy entries generally summarize complex variations, and the listed references, or the web page http://www.eos.ucar.edu/hirdls/, should be consulted before any use of the data. Additional products may be available in future versions.

Table 2. Information concerning HIRDLS Level 2 standard products.

Product	Field Name	Useful Range	Contact Name	Contact Email
Temperature	Temperature	400 - .04 hPa	John Gille	gille@ucar.edu
O_3	O3	260 - 0.5 hPa	Bruno Nardi	nardi@ucar.edu
HNO_3	HNO3	161 - 10 hPa	Douglas Kinnison	dkin@ucar.edu
CFC11 CFC12	CFC11 CFC12	287.3- 26.1 hPa 287.3- 10.0 hPa	Michael Coffey	coffey@ucar.edu
Cloud top pressure	CloudTopPressure	422 -> 10 hPa	Steven Massie	massie@ucar.edu
12.1MicronExtinction	12.1MicronExtinction	215 -> 20 hPa	Steven Massie	massie@ucar.edu
GPH	GPH	400 – .04 hPa	Lesley Smith	lsmith@ucar.edu
HDF5,HDF-EOS5	Library installation		GSFC DISC	help-disc @listserv.gsfc.nasa.gov
HDF-EOS5	*File structure and Content*		Cheryl Craig	cacraig@ucar.edu

* Depends on latitude

Note that the following references refer to the V3 data, but the descriptions of the data and the methods of evaluation are still applicable. In addition, one may consult the web page http://www.eos.ucar.edu/hirdls/

Gille et al., (2008), The High Resolution Dynamics Limb Sounder (HIRDLS): Experiment Overview, Results and Validation of Initial Temperature Data, *Journal of Geophysical Research*; doi:10.1029/2007JD008824, 2008.

Kinnison et al., (2008), Global Observations of HNO3 from the High Resolution Dynamics Limb Sounder (HIRDLS) – First Results, *Journal of Geophysical Research*; doi:10.1029/2007JD008814, 2008.

Massie et al., (2007), Validation of HIRDLS Observations PSC's and Subvisible Cirrus, *Journal of Geophysical Research*; doi:10.1029/2007JD008788, 2007.

Nardi et al., (2008), Validation of HIRDLS Ozone Measurements, *Journal of Geophysical Research*; doi:10.1029/2007JD008837, 2008.

1.3 Instrument Description

The Earth Observing System (EOS) High Resolution Dynamics Limb Sounder (HIRDLS) is one of four instruments flown on NASA's EOS Aura satellite, launched on July 15, 2004. Aura is in a near-polar 705 km altitude orbit. As the Earth rotates underneath it, the Aura orbit stays fixed relative to the sun to give daily global coverage with ~14 orbits per day. Aura is part of NASA's A-Train group of Earth observing

satellites. These satellites fly in formation making measurements within a short time of each other.

HIRDLS is a multi-channel, infrared limb-sounding radiometer designed to measure radiated thermal emissions from the atmospheric limb at various spectral intervals in the range of 6 to 17 μm, chosen to correspond to specific gases and atmospheric "windows". The final output will be a set of global 3-D fields of atmospheric temperature and several chemical constituents.

The HIRDLS measurements are made globally day and night. A key attribute of HIRDLS is the ability to measure at high vertical resolution (~1 km), which is significantly better than other instruments on Aura.

1.4 Brief background on algorithm

The Aura HIRDLS Level-2 processing stage ingests the Level-1 calibrated radiance data and generates Level-2 product data consisting of atmospheric profiles of geophysical quantities such as temperature and constituent mixing ratios on a pressure grid.

The user is encouraged to read the following documents for further details on algorithms and data quality.

- **HIRDLS Level-2 Algorithm Theoretical Basis Document**
  http://eospso.gsfc.nasa.gov/eos_homepage/for_scientists/atbd/docs/HIRDLS/ATBD-HIR-02.pdf

- **HIRDLS Data Description and Quality**
  http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/HIRDLS/documents/HIRDLS-V5-DQD.pdf (Collection 5)
  http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/HIRDLS/documents/V004Data-Qual-Doc_05Sep.pdf (Collection 4)

2. Data Organization

2.1 File naming convention

The Level-2 geolocated standard products are named in accordance to the following convention:

HIRDLS-Aura_L2_*v*_cxx*_<*yyyy*>d<*ddd*>*.he5* : for collection 5 (v5.00.00)
HIRDLS_*v*_cxx*_<*yyyy*>d<*ddd*>*.he5* : for collection 4 (v2.04.19)
* Note the added prefix from version 4 to 5.

For example:

HIRDLS-Aura_L2_v05-00-00-c01_2006d138.he5 : for collection 5
HIRDLS_v02-04-19-01-c01_2008d001.he : for collection 4

Where:

- **v* =** algorithm version identifier, made up of major version, minor version, and input data change
- **cxx =** file cycle number
- **yyyy** = four digit calendar year
- **ddd** = day number in the year (001=January 1)
- **he5** = format of the file (HDF-EOS5)

2.2 File Format

HIRDLS Level 2 data are stored in the HDF-EOS5 swath format and the data fields are described in the HDF-EOS Aura File Format Guidelines document (http://www.eos.ucar.edu/hirdls/HDFEOS_Aura_File_Format_Guidelines.pdf). HDF-EOS5 format is an extension of the HDF5 format (developed by the HDF Group) to meet the needs of EOS data products.

2.3 Data Structure inside File

An HDF-EOS5 swath is made of three major groups; “Dimensions”, “Geolocation fields”, and “Data fields” with Attributes for File Level, Swath Level, Geolocation fields and Data fields. More than one species can be contained within a swath and more than one swath can exist within a file.

Swath: The value for this name is not constrained.

Dimensions: dimensions of the Geolocation and Data field quantities.

Geolocation fields: describe the scientific measured quantities and provides information to aid in describing the data’s “location”.

Data Fields: actual scientific data.

2.4 Key data fields (see the following section for a complete list)

These are most likely to be used by users.

Dimensions:

- **nTimes:** number of times (profiles) in data set
- **nLevels:** number of pressure levels

Geolocation Fields:

- **Latitude:** Geodetic Latitude in degrees (-65 to +82)
- **Longitude :** Geodetic Longitude in degrees (-180 to +180)
- **Time**: Elapsed seconds since Jan 1, 1993 00:00:00 UTC (TAI-93)
- **LocalSolarTime:** hours
- **Pressure :** Pressure ordered from ground to space (in hPa)
- **SecondsInDay :** Seconds from midnight of day listed in global attributes

Data Fields

- **Temperature** : retrieved atmospheric temperature
- **O3 :** retrieved Ozone volume missing ratio
- **HNO3** : Nitric Acid volume mixing ratio
- **CFC11, CFC12**: volume missing ratio of $CFCl_3$ and CF_2Cl_2
- **CloudTopPressure**: in hPa
- **12.1MicronExtinction**: aerosol extinction at 12.1 microns
- **GPH**: Geopotential height (new in version 5)
- **RawGPH**: Raw Geopotential height (new in version 5)
- ***Species*Precision**: estimated precision of each data point (for instance, Temperature and *Temperature*Precision).

* Two additional fields for each species, SpeciesNormChiSq and SpeciesQuality have all values set to fill values.

* 12.1MicronExtinction has one additional field, 12.1MicronCloudAerosolFlag: 0=no contamination, 1=unknown cloud, 2=cirrus layer, 3=PSC, 4=saturated cloud, 99=anomaly detected
* CloudTopPressure, GPH and RawGPH do not have Precision, NormChiSq and Quality fields.

3. Data Contents

Described below are all the parameters contained within Aura HIRDLS Collection 4 Level-2 Product file.

3.1 Dimensions

Name	*Explanation*
nTimes	Along-track dimension, Number of times (profiles) in data set
nLevels	Vertical dimension, Number of Pressure levels
nCloudTypes	Number of cloud types

3.2 Geolocation Fields

Name	*Dimension*	*Data Type*	*Units*	*Notes*
Altitude	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	m	
Latitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	Geodetic Latitude
LocalSolarTime	(nTimes)	HE5T_NATIVE_FLOAT	h	(hours)
Longitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	range: [-180 to 180]
OrbitAscendingFlag	(nTimes)	HE5T_NATIVE_INTEGER		1= true then orbit is ascending
OrbitNumber	(nTimes)	HE5T_NATIVE_INTEGER	NoUnits	
Pressure	(nLevels)	HE5T_NATIVE_FLOAT	hPa	Pressure will be a superset of the UARS pressure levels (ordered from ground to space)
ProfileID	(nTimes)	HE5T_NATIVE_INTEGER	NoUnits	HIRDLS identification number for that day's profiles
ScanAzimuthAtNominalAltitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	range: [-180 to 180]
ScanElevationAtNominalAltitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	
ScanTable	(nTimes)	HE5T_NATIVE_INTEGER	NoUnits	HIRDLS Scan Table identifier
ScanUpFlag	(nTimes)	HE5T_NATIVE_DOUBLE	NoUnits	HIRDLS Scan Up dentifier 1=up (true)
ScienceScanMode	(nTimes)	HE5T_NATIVE_INTEGER	NoUnits	HIRDLS Science Scan Mode identifier (short integer)
SecondsInDay	(nTimes)	HE5T_NATIVE_FLOAT	sec	Seconds from midnight of day listed in global attributes
SolarZenithAngle	(nTimes)	HE5T_NATIVE_FLOAT	deg	
SpacecraftAltitude	(nTimes)	HE5T_NATIVE_FLOAT	m	A Height above WGS84 ellipsoid
SpacecraftLatitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	Geodetic latitude aboveWGS84 ellipsoid
SpacecraftLongitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	Longitude aboveWGS84 ellipsoid range: [-180 to 180]
TangentHeightAtNominalAltitude	(nTimes)	HE5T_NATIVE_FLOAT	m	
Time	(nTimes)	HE5T_NATIVE_FLOAT	sec	TAI time
ViewDirectionAtNominalAltitude	(nTimes)	HE5T_NATIVE_FLOAT	deg	East of North

3.3 Full Swath Data Fields

HDF-EOS Name	*Dimension*	*Data Type*	*Units*	*Notes*
Temperature	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	K	
TemperaturePrecision	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	K	
O3	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
O3Precision	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
HNO3	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
HNO3Precision	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
CFC11	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
CFC11Precision	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
CFC12	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
CFC12Precision	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	vmr	
12.1MicronCloudAerosolFlag	(nLevels,nTimes)	HE5T_NATIVE_INT8	see Note 1 below	Type of cloud identified
12.1MicronExtinction	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	1/km	
12.1MicronExtinctionPrecision	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	1/km	
CloudTopPressure	(nCloudTypes,nTimes)	HE5T_NATIVE_FLOAT	hPa	
GPH	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	m	
RawGPT	(nLevels,nTimes)	HE5T_NATIVE_FLOAT	m	

***** Note 1: 0=no contamination, 1=unknown cloud, 2=cirrus layer, 3=PSC, 4=saturated cloud, 99=anomaly detected

***** There are other unused data fields with values set to fill values.

3.4 Mandatory Attributes in File

The following attributes are ones that are mandatory to appear in the file. They are meant to provide additional information or to ease use of the data. For instance, while the date is provided in the attached metadata, the GranuleMonth/Day/Year attributes are provided as a simpler interface to this information.

3.4.1 File Level Attributes (HDF-EOS Global File Attributes)

This is information that helps to describe this particular data set. It can be useful in labeling plots, calculating dates, etc.

Attribute Name	*Data Type*	*Attribute Description*
InstrumentName	HE5T_NATIVE_CHAR	"HIRDLS"
ProcessLevel	HE5T_NATIVE_CHAR	Processing Level --- "L2"
GranuleMonth	HE5T_NATIVE_INT	Month of start of granule --- 1-12
GranuleDay	HE5T_NATIVE_INT	Day of start of granule ---- 1-31
GranuleYear	HE5T_NATIVE_INT	Year of start of granule ---- e.g.. 2004
TAI93At0zOfGranule	HE5T_NATIVE_DOUBLE	TAI time of 0z of granule
PGEVersion	HE5T_NATIVE_CHAR	Processing version

3.4.2 Swath Level Attributes

This is information which helps describe the swath

.

Attribute Name	*Data Type*	*Attribute Description*
Pressure*	HE5T_NATIVE_FLOAT	pressure levels
VerticalCoordinate	HE5T_NATIVE_CHAR	“Pressure”, “Altitude”, “Potential Temperature”, “Total Column”, "Slant Column"

* This attribute is an exact duplicate of the Pressure Geolocation Field. Writing the pressure data in two locations was agreed upon as a compromise between instrument teams. This attribute is only mandatory if VerticalCoordinate is "Pressure".

3.4.3 Geolocation and Data Field Attributes (HDF-EOS Local Attributes)

This is information that helps to describe the individual data fields. Data Field Attributes are a feature which can be useful in annotating plots as well as describing the data product to input routines. If ScaleFactor and Offset are not applicable they may be omitted.

Attribute Name	*Data Type*	*Attribute Description*
MissingValue	Same type as Data Field	Contains the value for missing data (-999.0, -999, or -99)
Title	HE5T_NATIVE_CHAR	For labeling a plot or axis
Units	HE5T_NATIVE_CHAR	Labeling units (for labeling color bars, converting between units, etc). After applying scale and offset, if applicable.
UniqueFieldDefinition1	HE5T_NATIVE_CHAR	Describes if definition of field is shared with other Aura Instruments ("Aura-Shared", "X-Specific", where X=Instrument Name, "X-Y[-Z]-Shared" where X,Y, and optional Z are instrument names (in alphabetical order)
ScaleFactor	HE5T_NATIVE_DOUBLE	Factor for scaling data (mandatory only if applicable)

In addition to the attributes listed above, the *FillValue* attribute is recommended. Its value can be recovered by a call to he5_SWgetfill (HE5_SWgetfillvalue for C users) if using swath format, he5_GDgetfill (HE5_GDfillvalue for C users) if using grid format, he5_ZAgetfill (HE5_ZAfillvalue for C users) if using zonal average format. If it is used, its attribute type and value must be the same as data field and the *MissingValue* attribute. Its literal name is set automatically and is not under the control of the instrument teams. In the form implemented by the HDFEOS library at the time of this writing that literal name is *_FillValue*.

UniqueFieldDefinition is used to indicate to end-users if data from different instruments can be considered to have the same definition. If X-Specific is set, then instrument X has a unique definition of this field. If X-Y-Shared is set, then Instruments X and Y are using the same definition for this field. "Aura-Shared" indicates the same definition is used for

all Aura instruments. Note that definitions can be shared even if dimensionalities are different.

4. Options for Reading Data

The HDF Group provides various utilities for viewing the contents of HDF files and extracting the raster, binary, or ASCII objects (see http://hdf.ncsa.uiuc.edu/products/index.html) that are free to use.

4.1 Command line tools

The **h5dump** enables the user to examine the contents of an HDF5 file and dump those contents, in human readable form, to an ASCII or binary file.

```
h5dump options filename
```

```
Options/Arguments:
```

`-h` or `--help`	Print a usage message and exit.
`-B` or `--bootblock`	Print the content of the boot block. *(This option is not yet implemented.)*
`-H` or `--header`	Print the header only; no data is displayed.
`-A`	Print the header and value of attributes;
`-i` or `--object-ids`	Print the object ids.
`-r` or `--string`	Print 1-bytes integer datasets as ASCII.
`-V` or `--version`	Print version number and exit.

The following website (http://www.hdfgroup.org/HDF5/doc/RM/Tools.html#Tools-Dump) provides more detailed information.

The **H5ls** is also available and will list contents of HDF5 as well as HDF-EOS5 file.

4.2 GUI tools

The HDFView (http://www.hdfgroup.org/hdf-java-html/hdfview/) is a visual tool for browsing and editing NCSA HDF4 and HDF5 files and is available for various platforms (Windows 98/NT/2000/XP, Solaris, Linux, AIX, Irix 6.5, MacOSX) and free to download.

Users, especially **those who are not familiar with Unix/Linux environment** are strongly encouraged to use **HDFView** for a quick access to data contents.
There is also an optional plug-in for handling HDF-EOS data files, which you can download from: http://opensource.gsfc.nasa.gov/projects/hdf/hdf.php

4.3 Read software in C, Fortran and IDL

Aura HIRDLS science team provides number of reader software and format converters written in C, IDL, and FORTRAN programming language. You can download them from GES DISC web site: http://disc.sci.gsfc.nasa.gov/Aura/tools.shtml.

4.4 A sample reader in IDL

The following sample reader is taken from http://www.eos.ucar.edu/hirdls/data/access.shtml.

Warning: Due to internal changes within the HDF5 library used to create V5 data, IDL must be upgraded to 7.1 in order to read the HIRDLS V5 data.

```
FUNCTION HandleAttribute, FileId, dataname, attrname, data, swathname=swathname,
verbose=verbose, success=success

geo_group = "Geolocation Fields"
dat_group = "Data Fields"

;; get the swathname
IF N_ELEMENTS(swathname) EQ 0 THEN $
BEGIN
   IF h5g_get_nmembers(FileId, '/HDFEOS/SWATHS/') EQ 1  THEN swathname =
h5g_get_member_name(FileId, '/HDFEOS/SWATHS/', 0) ELSE swathname = dataname
ENDIF

msgtce='>>HandleAttribute traceback:'

;; set counter for number of attempted reads
NPASS = 1

;; if attrname is not a string type (i.e./attrname) then get attribute data
IF SIZE(/TYPE, attrname) NE SIZE(/TYPE,"") THEN $
  BEGIN
    attrname = dataname
    NPASS = 1 ;; group attribute
END ELSE BEGIN
    IF  attrname EQ dataname THEN $
      BEGIN
        NPASS = 1 ;; group attribute
    END ELSE BEGIN
        NPASS = 5 ;; dataset attribute
    END
END

;; on error jumps back to this line
CATCH, error_statusa

IF  error_statusa NE 0 THEN $
  BEGIN
    CATCH, error_statusa, /cancel
    NPASS = NPASS + 1
ENDIF

;; create HDF path to variable
IF NPASS EQ 1 THEN GrpName = '/HDFEOS/ADDITIONAL/FILE_ATTRIBUTES/'
IF NPASS EQ 2 THEN GrpName = '/HDFEOS/SWATHS/' + swathname + '/'
```

```
IF NPASS EQ 3 THEN GrpName = '/HDFEOS/SWATHS/'
IF NPASS EQ 4 THEN GrpName = '/HDFEOS/'
IF NPASS EQ 5 THEN DsName  = '/HDFEOS/SWATHS/' + swathname + '/' + geo_group + '/' + dataname
+'/'
IF NPASS EQ 6 THEN DsName  = '/HDFEOS/SWATHS/' + swathname + '/' + dat_group + '/' + dataname
+'/'

IF NPASS GT 6 THEN $
  BEGIN
    print, TRANSPOSE(msgtce)
    print, '>'+ attrname + ' not found.. Sorry!'
    CATCH,/cancel
    RETURN, -1
END

CASE 1 OF
    NPASS LE 4: BEGIN ;; Group
        msgtce = [msgtce,">>>searched: " + GrpName + attrname]
        GrpId = h5g_open(FileId, GrpName)
        AtId  = h5a_open_name(GrpId, attrname)
        data  = h5a_read(AtId)
        h5a_close, AtId
        h5g_close, GrpId
    END
    ELSE :BEGIN ;; Dataset
        msgtce = [msgtce,">>>searched: " + DsName + attrname]
        DsId  = h5d_open(fileid, DsName)
        AtId  = h5a_open_name(DsId, attrname)
        data  = h5a_read(AtId)
        h5a_close, AtId
        h5d_close, DsId
    END
ENDCASE

IF N_ELEMENTS(success) NE 0 THEN print, '>Located:'+msgtce(N_ELEMENTS(msgtce)-1)
IF N_ELEMENTS(verbose) NE 0 THEN print, TRANSPOSE(msgtce)
RETURN, 0
END

Function HandleDataField, FileId, dataname, data, swathname=swathname,  verbose=verbose,
success=success
;; get named geo/data field

geo_group = "Geolocation Fields"
dat_group = "Data Fields"

IF N_ELEMENTS(swathname) EQ 0 THEN $
BEGIN
    IF h5g_get_nmembers(FileId, '/HDFEOS/SWATHS/') EQ 1  THEN swathname =
h5g_get_member_name(FileId, '/HDFEOS/SWATHS/', 0) ELSE swathname = dataname
ENDIF

msgtce='>>HandleDataField traceback:'

;; set counter for number of attempted reads
NPASS = 1
```

```
;; on error jumps back to this line
CATCH, error_statusd

IF  error_statusd NE 0 THEN $
  BEGIN
    CATCH, error_statusd, /cancel
    NPASS = NPASS + 1
ENDIF

;; create HDF path to variable
IF NPASS EQ 1 THEN DsName ='/HDFEOS/SWATHS/' + swathname + '/' + geo_group + '/' + dataname
IF NPASS EQ 2 THEN DsName ='/HDFEOS/SWATHS/' + swathname + '/' + dat_group + '/' + dataname

IF NPASS GT 2 THEN $
  BEGIN
    print, TRANSPOSE(msgtce)
    print,  '>'+ dataname + ' not found.. Sorry!'
    CATCH,/cancel
    RETURN, -1
END

msgtce = [msgtce,">>>searched: " + DsName]
DsId = h5d_open(fileid, DsName)

DspId = h5d_get_space(DsId)
Dims  = h5s_get_simple_extent_dims(DspId)
h5s_close, DspId

dspidm = h5s_create_simple(dims)
data = h5d_read(dsid, FILE_SPACE=dspidm)
h5s_close, DspIdM
h5d_close, DsId

data = reform(data)

IF N_ELEMENTS(success) NE 0 THEN print, '>Located:'+msgtce(N_ELEMENTS(msgtce)-1)
IF N_ELEMENTS(verbose) NE 0 THEN print, TRANSPOSE(msgtce)
RETURN, 0
END

FUNCTION get_aura, file, varname, data, swathname=swathname, attrname=attrname,
verbose=verbose, success=success
;+
; NAME:
;             get_aura
;
; PURPOSE:
;       extract data from Aura style HDF5-EOS file
;
;
; CATEGORY:
;             HDF5-EOS file reader
;
; CALLING SEQUENCE:
;       status = get_aura(file, varname, data)
```

```
;
; INPUTS:
;       file is the file path
;       varname (+attrname) is the HDF5-EOS object
;
;       dafault is to first search varname as geo/data set then as group attribute
;
; KEYWORD PARAMETERS:
;       attribute:
;               may be set as /attr if varname is a group attribute object
;               may be set as attr='<name>' if attribute is attached
;               to varname
;
;       /verbose :
;               produces printout of all searched locations
;
;       /success :
;               produces printout of sucessful search location
;
;
; OUTPUTS:
;               data is the returned IDL data variable name
;       returns status as 0 for success and -1 for failure
;
;       sucessful location of requested data object is not notified
;       unless keyword /success is set
;
;       failure to find data object results in traceback of searched
;       locations
;
; EXAMPLES:
;
; 1) extract datsets
;
; extract the HIRDLS 'Temperature' dataset and put into variable t and
; be quiet if successful
; status = get_aura('HIRDLS.he5','Temperature',t)
;
; extract the MLS 'Latitude' dataset and put into variable lats and
; report success
; status = get_aura('MLS.he5','Latitude',lats, /succ)
;
; 2) extract attributes associated with a particular dataset
;
; extract the 'Units' attribute from the 'Temperature' dataset and put into variable x
; status = get_aura('HIRDLS.he5','Temperature', x, attr='Units')
;
; 3) extract attributes associated with groups
;
; extract the 'InstrumentName' attribute and put into variable x
; status = get_aura('HIRDLS.he5','InstrumentName', x, /attr)
;
; extract the 'GranuleMonth' attribute and put into variable x and be verbose
; status = get_aura('HIRDLS.he5','GranuleMonth', x, /attr, /verb);
;
;
```

```
; MODIFICATION HISTORY:
;       from original get_sw_data5 by K. Stone and J. McInerney UCB/CLAS
;       A. Lambert NCAR
;       AL 01-NOV-2003 revised version of get_sw_data5
;       AL 04-NOV-2003 added automatic swath name recognition
;       AL 27-MAY-2004 added default of searching in group attributes
;                       if data/geo field not found; added verbose and
;                       success keywords
;
;-

FileId = h5f_open(file)
IF FileId EQ -1 THEN MESSAGE, "File does not exist."

CASE N_ELEMENTS(attrname) OF
   0: BEGIN
      status = HandleDataField(FileId, varname, data, swathname=swathname, verbose=verbose,
success=success)
      IF status(0) EQ -1 THEN $
        BEGIN
          print,'>Now searching as group attribute:'
          status = HandleAttribute(FileId, varname, varname, data, swathname=swathname,
verbose=verbose, /success)
      ENDIF
   END
   ELSE: status = HandleAttribute(FileId, varname, attrname, data, swathname=swathname,
verbose=verbose, success=success)
ENDCASE

h5f_close,FileId

RETURN, status
END
```

5. Data Services and Interpretation

5.1 Aura HIRDLS File Service

GES DISC has a search engine for users to limit number of files for download by specifying appropriate temporal constraints in search; Mirador (http://mirador.gsfc.nasa.gov/). The total download size can be further reduced by choosing a spatial subsetting within Mirador.

For data access and related services, check the following web site.
http://disc.sci.gsfc.nasa.gov/Aura/data_access.shtml

HIRDLS data can also be viewed from Giovanni (GES DISC online visualization and analysis tool). Currently only vertical profile plots are supported:
http://disc.sci.gsfc.nasa.gov/techlab/giovanni/

5.2 Interpretation and Screening

Detailed information on data quality can be found in EOS HIRDLS Level 2 Version 5 data description and quality document (http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/HIRDLS/documents/HIRDLS-V5-DQD.pdf)

6. More Information

6.1 Web resources for Aura HIRDLS data users:

HIRDLS US/UCAR:

- HIRDLS Main Page: http://www.eos.ucar.edu/hirdls/
- HIRDLS Documentation: http://www.eos.ucar.edu/hirdls/docs/
- Data Validation : http://www.eos.ucar.edu/hirdls/data/validation.shtml

HIRDLS UK/Oxford:

- HIRDLS Main Page: http://www.atm.ox.ac.uk/hirdls/

NASA/GSFC:

- HIRDLS Data Support Main Page: http://disc.gsfc.nasa.gov/Aura/
- HIRDLS Products & Data Access: http://disc.gsfc.nasa.gov/Aura/data-holdings/HIRDLS/
- HIRDLS Documentation: http://disc.gsfc.nasa.gov/Aura/documentation/
- Data can also be obtained from Giovanni (online visualization and analysis tool): http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=hirdls
- HIRDLS FAQ (from Giovanni): http://disc.sci.gsfc.nasa.gov/techlab/giovanni/G3_manual_Chapter_14_HIRDLS.shtml

6.2 Point of Contact

URL	http://disc.gsfc.nasa.gov/	
Contact	Name	GES DISC HELP DESK SUPPORT GROUP
	Email	help-disc@listserv.gsfc.nasa.gov
	Phone	301-614-5224
	Fax	301-614-5268
	Address	Goddard Earth Sciences Data and Information Services Center, Code 610.2 NASA Goddard Space Flight Center, Greenbelt, MD, 20771, USA

7. Acronyms

ACE Atmospheric Chemistry Experiment
ACE-FTS Atmospheric Chemistry Experiment Fourier Transform Spectrometer
ATBD Algorithm Theoretical Basis Document
ATMOS Atmospheric Trace Molecule Spectroscopy
CFC Chlorofluorocarbons
CRISTA Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere
DAAC Distributed Active Archive Center
DISC Data and Information Services Center
ECMWF European Centre for Medium Range Weather Forecasts (UK)
ECS EOSDIS Core System
EDOS Earth Observing System Data and Operations System
EOS Earth Observing System
EOSDIS Earth Observing System Data and Information System
ESDT Earth Science Data Type
EU Engineering Unit
FOV Field of View
FWHM Full Width Half Maximum
GES Goddard Earth Sciences
GES DISC Goddard Earth Sciences Data and Information Services Center
GMAO Goddard Modeling and Assimilation Office
GSFC Goddard Space Flight Center
HALOE Halogen Occultation Experiment
HDF Hierarchical Data Format
HDF5 Hierarchical Data Format Version 5.X
HDF-EOS Hierarchical Data Format for the EOS mission
HIRDLS High Resolution Dynamics Limb Sounder
IDL Interactive Data Language
JPL Jet Propulsion Laboratory
L1A Level 1A Data
L1B Level 1B Data
L2 Level 2 Data
L3 Level 3 Data
LGID Local Granule Identification
Limb sounding A horizon-looking observation technique that uses a distant objects sun, start, or a sensor on another satellite in a different Earth orbit
MCF Metadata Configuration File
MIPAS Michelson Interferometer for Passive Atmospheric Sounding
MkIV Mark IV Spectrometer
MLO Mauna Loa Observatory
MLS Microwave Limb Sounder
MW Microwave
NASA National Aeronautics and Space Administration
NCAR National Center for Atmospheric Research

NCEP National Centers for Environmental Prediction
NESDIS National Environmental Satellite, Data and Information Service
NOAA National Oceanic and Atmospheric Administration
OLR Outgoing Longwave Radiation
OMI Ozone Monitoring Instrument
PGE Product Generation Executive
PGS Product Generation System
PREPQC NCEP quality controlled final observation data
PSC's Polar Stratospheric Clouds
QA Quality Assessment
RTA Radiative Transfer Algorithm
SAGE III Stratospheric Aerosol and Gas Experiment III
s.d. Standard Deviation
SPS Science Processing System
ST Scan Table
TAI International Atomic Time
TES Tropospheric Emission Spectrometer
TMF Table Mountain Facility
URL Universal Reference Link
UTC Coordinated Universal Time
UTLS Upper Troposphere – Lower Stratosphere
VIS Visible
WMO World Meteorological Organization
VMR Volume Mixing Ratio
WAVES Water Vapor Validation Experiment Satellite/Sondes
WOUDC World Ozone and Ultra-Violet Radiation Data Center