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HDF-EOS to GeoTIFF Conversion Tool (HEG) Stand-alone User's Guide

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Preface

The Synergy program, under the auspices of NASA's Earth Observing System Program, provided a tool for the conversion of HDF-EOS formatted granules to Geographical Information System (GIS) compatible formats, namely GeoTIFF. The initial focus of the development was to provide conversion for standard science products produced by the MODIS, MISR and ASTER instruments. Support for other products, such as products produced by AMSR-E and AIRS instruments, were later added to the tool. The tool is available as a stand-alone product, and is meant to be downloaded to a user workstation. The tool also is designed to be used in a web or other client – based interface, connected to on-line data storage.

This document was formerly known as 170-TP-013-001, HDF-EOS Data Format Converter User's Guide, under the ECS Project.

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Abstract

This document describes a software tool which provides conversion functionality for HDF-EOS formatted granules. The tool will reformat HDF-EOS Swath and Grid data to HDF-EOS Grid, GeoTIFF, or to a generic binary format. The tool can also be used to re-project data from its original projection to other standard projections, to subset data, and to mosaic/stitch adjacent granules together. Swath data can be converted to Grid data. The tool is available as a downloadable tar file.

Keywords: HDF-EOS, GeoTIFF, GIS, Subsetter

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Contents

Preface

Abstract

1. Introduction

1.1	Identification	1-1
1.2	Scope	1-1
1.3	Purpose and Objectives	1-1
1.4	Status and Schedule	1-1
1.5	Document Organization	1-1

2. Related Documentation

2.1	Parent Documents	2-1
2.2	Related Documents	2-1

3. Operations Concept

4. Download and Installation Instructions

4.1	Download Instructions	4-1
4.2	Install Instructions	4-2
4.2.1	Installation on SUN/SGI/Linux/MAC	4-2
4.2.2	Installation on Win98/NT/2000/XP	4-4

5. HEG Graphical User Interface

5.1	HEG Conversion Window	5-1
-----	-----------------------------	-----

5.2	HDF-EOS Stitch/Subset Window.....	5-6
5.3	Examples of Usage	5-9
5.3.1	Grid Conversion.....	5-10
5.3.2	Swath Conversion	5-14
5.3.3	HEG Stitch/Subset Tool Examples.....	5-16
5.3.4	Grid Stitch/Subset.....	5-16
5.3.5	Swath Stitch/Subset	5-19

6. Software Architecture

6.1	HDF-EOS to GeoTIFF Conversion Tool.....	6-1
6.2	HEG Subset/Stitch Tool.....	6-2

7. Command Line Interface

7.1	Introduction.....	7-1
7.2	hegtool.....	7-1
7.2.1	hegtool Usage.....	7-1
7.2.2	Format of Header Files	7-1
7.2.3	An Example of a HegHdr.hdr File.....	7-5
7.2.4	Header File Data Ordering.....	7-8
7.2.5	MISR Block Header File	7-8
7.2.6	An Example of a HegMisrCoords.hdr File.....	7-9
7.2.7	Reading the Header Files	7-10
7.3	gdtif.....	7-11
7.3.1	gdtif Usage.....	7-11
7.3.2	Parameter Files.....	7-11
7.3.3	Parameter File Format.....	7-11
7.3.4	Sample of a Parameter File for gdtif.....	7-14
7.4	resample	7-14
7.4.1	resample Usage.....	7-15
7.4.2	Parameter File Format.....	7-15
7.4.3	Sample of a Parameter File for resample.....	7-17
7.5	swtif.....	7-18

7.5.1	swtif Usage.....	7-18
7.5.2	Parameter File Format.....	7-18
7.5.3	An Example of a Parameter File for swtif	7-21
7.6	SWATH SUBSET/STITCH	7-21
7.6.1	Program subset_stitch_swath Usage.....	7-22
7.6.2	Parameter File Format.....	7-22
7.6.3	An Example of a Parameter File for subset_stitch_swath	7-25
7.7	Grid Subset/Stitch	7-25
7.7.1	Program subset_stitch_grid Usage.....	7-26
7.7.2	Parameter File Format.....	7-26
7.7.3	An Example of a Parameter File for subset_stitch_grid	7-29
7.8	Subsample_grid.....	7-29
7.8.1	Program subsample_grid Usage	7-29
7.8.2	Parameter File Format.....	7-29
7.8.3	Example Parameter Files for subsample_grid	7-32

8. Output Data Formats

8.1	Raw Binary File Description	8-1
8.1.1	Binary File Description.....	8-1
8.1.2	Header File.....	8-1
8.1.3	Reading the Binary File	8-4
8.2	ASCII Metadata	8-5

List of Figures

5-1.	HEG Conversion Window.....	5-1
5-2.	File Selection Window	5-2
5-3.	Subsampling Dialogue Window.....	5-5
5-4.	HEG Projection Parameters Window	5-5
5-5.	HEG HDF-EOS Stitch/Subset Window	5-7
5-6.	Objects Combo Box.....	5-10
5-7.	Fields List	5-10

5-8. Spatial Subset Area.....	5-11
5-9. GeoTIFF Conversion Window Containing Example.....	5-13
5-10. Swath Example.....	5-15
5-11. No Match Warning.....	5-16
5-12. Grid Stitch/Subset Example.....	5-18
6-1. Overview of HEG Tool.....	6-2
6-2. Overview of Stitch/Subset Function.....	6-3

Appendix A. List of Supported Products

Appendix B. State Plane Zones and Values

1. Introduction

1.1 Identification

The HDF-EOS to GeoTIFF Conversion Tool (HEG) Users Guide was prepared under the Earth Observing System Data and Information System (EOSDIS) Maintenance and Development (EMD) Contract (NAS5-03098).

1.2 Scope

This document is a user's guide for the Stand-alone version of the HDF-EOS to GeoTIFF Conversion Tool (HEG) software.

1.3 Purpose and Objectives

This document will provide a user with a description of the functionality implemented by the HEG stand-alone software. The document describes usage of the HEG stand-alone software by both Graphical User Interface (GUI) and command line interfaces. The document is meant to have sufficient detail to enable complete use of the software.

1.4 Status and Schedule

April 1, 2001 – Software development begun

Nov. 15, 2001 – Beta version available to selected users

Dec. 24, 2001 – Version 1.0 available to general users

Jan. 15, 2002 - Software turned over to ECS Development (Synergy Program)

November, 2004 – Version 2.0 available to general users

1.5 Document Organization

This document is organized as follows:

Section 1. Introduction

Section 2. Related Documentation

Section 3. General description and operations concept

Section 4. Instructions for downloading and building software

Section 5. Description of the Graphical User Interface (GUI)

Section 6. Software module diagrams

Section 7. Description of the command line interface

Section 8. Output data formats

Appendix A. List of Supported Products

Appendix B. State Plane Zones

2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content are derived:

none

2.2 Related Documents

The following documents are referenced within this technical paper, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this document.

333-EMD-001	Release 7 SCF Toolkit Users Guide for the ECS Project
170-EMD-001	HDF-EOS Library User's Guide Volume 1: Overview and Examples
170-EMD-002	HDF-EOS Library Users Guide Volume 2: Function Reference Guide HDF User's Guide, V 4.1r5, NCSA, U of Illinois, Campaign, IL, 2001 HDF Specification and Developer's Guide, V 4.1r5, NCSA, U of Illinois, Campaign, IL, 2001 HDF Reference Manual, V 4.1r5, NCSA, U of Illinois, Campaign, IL, 2001
none	An Album of Map Projections, USGS Professional Paper 1453, Snyder and Voxland, 1989
none	Map Projections - A Working Manual, USGS Professional Paper 1395, Snyder, 1987

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3. Operations Concept

EOS Terra and Aqua, launched in December 1999 and May 2002 respectively, carry instruments which provide observations of the earth at many wavelengths and spatial resolutions. The data are used to provide scientists, policy makers and others with a continuous record of parameters used to characterize, for example, land use, pollutant transport and climate change.

The standard format for EOS instrument data is HDF-EOS, which is derived from the National Center for Supercomputers (NCSA) HDF format. HDF is a self-describing, portable format for scientific data. HDF-EOS applies standards for attaching geolocation and temporal information to scientific data. Most EOS data products are stored and distributed in this format. HDF-EOS files also contain core and product-specific metadata. The former metadata are also stored in databases for user search and access.

HDF-EOS is not generally accessible to common GIS applications, such as ArcInfo, ENVI and ERDAS. In order that EOS data is accessible to the GIS and land process community in general, it needs to be converted into a standard format for that community. In order that the data is useful to any group of users, that data must be accessible to application tools commonly used by that community. For example, tools commonly used in Geographical Information Systems (GIS), often require that data be in a common format, such as GeoTIFF. The most common format is GeoTIFF. Furthermore, the data needs to be stored in a common geographic projection, such as UTM, Space Oblique Mercator, or Homolosine.

Land products from ASTER and MODIS come in HDF-EOS Swath and Grid formats. Swath products are multiple band and in geographic coordinates. In the case of ASTER, the data are geolocated in UTM coordinates. Swath data are primarily organized by temporal index. Grid data are projected onto a regular grid in one of several coordinate systems.

MODIS products are in Swath and Grid format, SIN (or ISIN) and CMG projection systems. MODIS Level 1 and 2 products have geolocation information, which is in a separate file. ASTER products are uniform in format. MODIS products, on the other hand have a variety of storage methods. MISR data are stored in 'blocks', of up to 180 per dayside path. In order to make MISR data more amenable to comparison with other data, blocks must be extracted, stitched together and subsetted.

The HDF-EOS to GeoTIFF Conversion Tool (HEG) will allow a user working on his/her workstation to reformat, re-project and perform operations such as subsetting, stitching, or subsampling on a selectable HDF-EOS object. The output file produced by the tool will be ingestible into commonly used GIS applications. The Tool also allows the user to select other output formats, binary and HDF-EOS Grid, or for the case of ASTER L1B products a satellite-path oriented grid. The output data can be in other projections selected from the USGS General Coordinate Transformation Package (GCTP). Access to and processing of HDF-EOS input will be controllable from a GUI or from a command line interface. The GUI or command line

interface allows selection of file and object to be processed, a new projection for output, a lat/long box to subset, output file format, and output file location.

It is expected that a user will have access to a number of files in his/her local directory. The HEG tool can access and process files in this local directory. Processed files will contain original and new metadata.

The Stand-alone version of the HEG is built in C and Java, with both a GUI and a command line interface.

The HDF-EOS to GeoTIFF Conversion Tool is available to the user community at an ftp site, from which users may download the Tool and its command line interface or GUI. The current version of the tool operates on SGI, Sun, Linux, MAC and Windows platforms.

4. Download and Installation Instructions

4.1 Download Instructions

HEG is available on an anonymous ftp site. Four tar files for SUN/SGI/Linux/MAC and a zip file for Win98/NT/2000/XP are available:

- hegSGIv2.9.tar.Z - built on SGI Irix 6.5
- hegSUNv2.9.tar.Z - built on Sun Solaris 2.10
- hegLNXv2.9.tar.gz - built on Linux Red Hat Enterprise
- hegWINv2.9.zip built on PC with Windows XP
- hegMACv2.9.tar.gz - built on MAC OSX

All Java code built using Java Version 1.4 or higher. Therefore, Java 1.3 or later will be required to run HEG.

To begin download, type the following command line ftp, or download from <http://newsroom.gsfc.nasa.gov/sdptoolkit/HEG/HEGDownload.html>:

```
ftp edhs1.gsfc.nasa.gov
```

```
Name: anonymous
```

```
Password: <your e-mail address>
```

```
ftp> quote site group sdptk
ftp> quote site gpass ecs-tkit
ftp> cd edhs
ftp> cd HEG_Tool
```

Get the tar file you need:

```
ftp> binary
ftp> get hegSGIv2.9.tar.Z
    OR
ftp> get hegSUNv2.9.tar.Z
    OR
ftp> get hegLNXv2.9.tar.gz
    OR
ftp> get hegWINv2.9.zip
    OR
ftp> get hegMACv2.9.tar.gz
```

If the user wishes to download the User's Guide, type:

```
ftp> get HEG_UsersGuide_V2.9.doc
```

```
ftp> bye
```

This completes downloading the HEG tar files.

4.2 Install Instructions

4.2.1 Installation on SUN/SGI/Linux/MAC

There are two ways to install HEG on your system:

1. Run the install script
2. Manually install HEG

IMPORTANT: Before installing HEG, make sure you have Java 1.3 or greater installed on your system.

1. RUNNING THE INSTALL SCRIPT

* Uncompress and extract the files contained in the tar file.

```
uncompress hegSGIv2.9.tar.Z
```

```
tar -xvf hegSGIv2.9.tar
```

OR

```
uncompress hegSUNv2.9.tar.Z
```

```
tar -xvf hegSUNv2.9.tar
```

OR

```
gunzip hegLNxv2.9.tar.gz
```

```
tar -xvf hegLNxv2.9.tar
```

OR

```
gunzip hegMACv2.9.tar.gz
```

```
tar -xvf hegMACv2.9.tar
```

NOTE: Once the install script runs, it will automatically remove heg<SGI/SUN/LNX/MAC>.tar from your current directory. If you want to backup this file, now is the time to do so.

* Run the install script

```
./install
```

NOTE: The install script will ask you a series of questions to assist you in installing HEG on your system

* Once HEG is installed, go to the directory in which you installed HEG, go to the bin directory, and invoke the HEG script to load up the HEG GUI.

For example, if HEG is installed in /home/bob/heg,

```
cd /home/bob/heg/bin
./HEG
```

* ENJOY!

2. MANUALLY INSTALL HEG

Make a heg directory in your home directory:

```
cd $HOME
mkdir heg
```

Change to the heg directory and copy the tar file to that location.

```
cd heg
mv (location of tar file/heg<SGI/SUN/LNX/MAC>.tar.Z .
```

Uncompress and extract the files contained in the tar file and start HEG.

```
uncompress hegSGIv2.9.tar.Z
tar -xvf hegSGIv2.9.tar
    OR
uncompress hegSUNv2.9.tar.Z
tar -xvf hegSUNv2.9.tar
    OR
gunzip hegLNXv2.9.tar.gz
tar -xvf hegLNXv2.9.tar
    OR
gunzip hegMACv2.9.tar.gz
tar -xvf hegMACv2.9.tar
```

After uncompressing and extracting, you will get two files, install and heg.tar. Ignore the install file.

Extract the files contained in the heg.tar file and start HEG.

```
tar -xvf heg.tar
```

```
cd bin
HEG
```

HEG has been installed and should be running

4.2.2 Installation on Win98/NT/2000/XP

1. Install java (jdk1.4 or newer windows version).
2. Put the hegWINv2.9.zip in a new directory and unzip it to the current directory.
3. Double click on install.bat and follow the instruction in MS-DOS window that appears.
4. A file heg.bat will be created by the installation. Copy that file into
<the subdirectory where heg is installed>\HEG_Win\bin

Note: On Win2000 the installation will automatically create the file HEGTool.bat in the bin directory. Use that file instead of heg.bat mentioned below.

5. Go to the bin directory, where heg.bat was copied to, and write click on heg.bat. Click on the **Properties** and then click on the **Program** tab. Click on the **Change Icon**, then click on **Browse** and select the file "heg.ico" in the bin directory.

Note: On Win2000 first create a shortcut to HEGTool.bat, and write click on that. Click on the **Properties** and then click on the **Program** tab. Click on the **Change Icon**, then click on **Browse** and select the file "heg.ico" in the bin directory.

6. Once this is done a "shortcut to heg.bat" will be created. If this did not happen automatically, right click on heg.bat, and click on **Create Shortcut**.

Note: On Win2000 the "shortcut to HEGTool" can be used to put a shortcut on desktop.

7. To run HEG Double click on the created shortcut(s).

5. HEG Graphical User Interface

5.1 HEG Conversion Window

The HDF-EOS to GeoTIFF Conversion Tool (HEG) has a graphical user interface (GUI) which uses Java Swing technology. The user interface consists of two (2) main windows. The first window is for the selection of HDF-EOS files for conversion into the GeoTIFF format. The second window is for stitching and subsetting common HDF-EOS files.

The main purpose of the HEG tool is to assist users in creating files that are more useful and informative. The HEG tool works specifically on HDF-EOS Swath and Grid objects. An HDF-EOS object is a structure, built on HDF arrays, tables and attributes. The object is self-described by machine- and human-readable metadata. The objects are accessible via a software interface, the HDF-EOS library. For a detailed explanation of a Swath or Grid object, please refer to the HDF-EOS Library User's Guide.

The Java Swing widget set is comparable to the widget set of X-Windows and MS-Windows. Therefore, an HEG user should be able to become a proficient user of the tool after a short period of time.

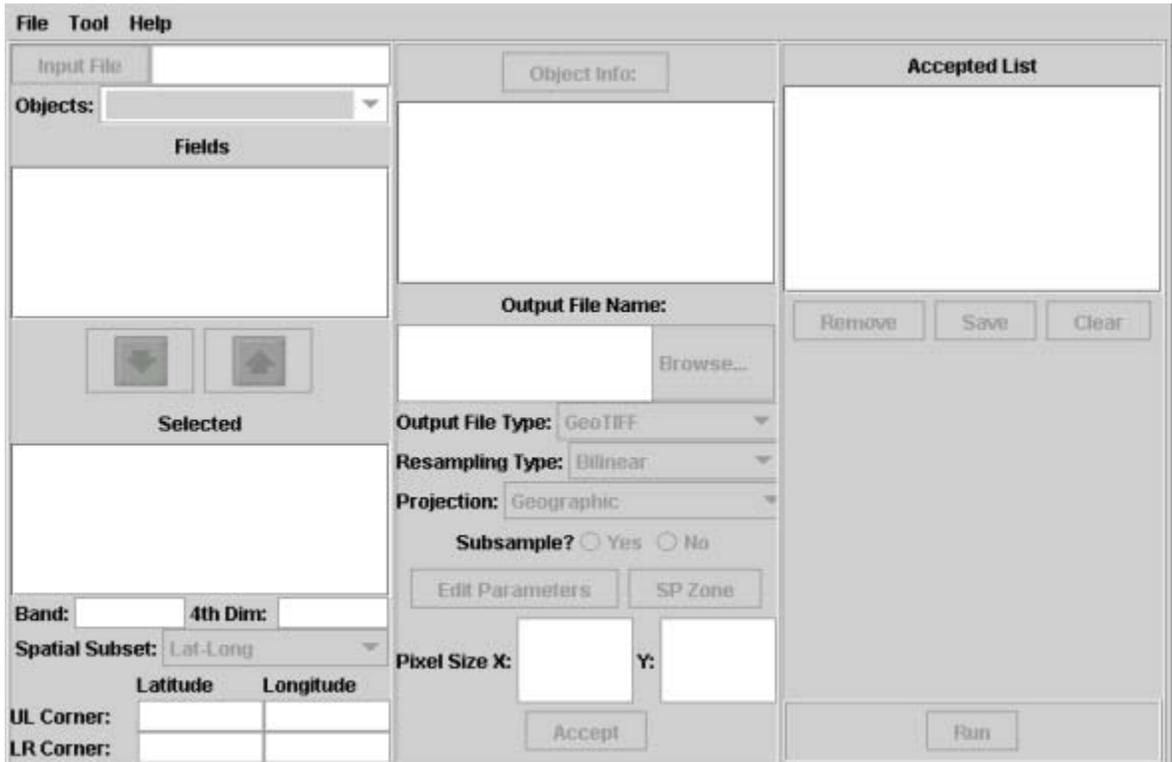


Figure 5-1. HEG Conversion Window

Figure 5-1 is a snapshot of the HEG GeoTIFF Conversion Window. The data in this window may be converted to GeoTIFF, Non-standard binary, or HDF-EOS Grid formats. The window is divided into 4 basic sections: a menu bar, left panel, center panel, and right panel. In the description of the window widgets, it must be noted that an object is an HDF-EOS Swath or Grid.

Menu Bar

The menu bar on the GeoTIFF conversion window contains three options File, Tool, and Help.

The File menu bar option allows the user to open an Hdf-Eos file or exit the HEG tool. To open an HDF-EOS file the user will click on *File – Open*. A file selection window (Figure 5-2) would appear allowing the user to browse through the directory structure and pick the desired HDF-EOS file for viewing. In order to exit the HEG tool, the user will select *File – Exit*, which causes the HEG GUI to close.

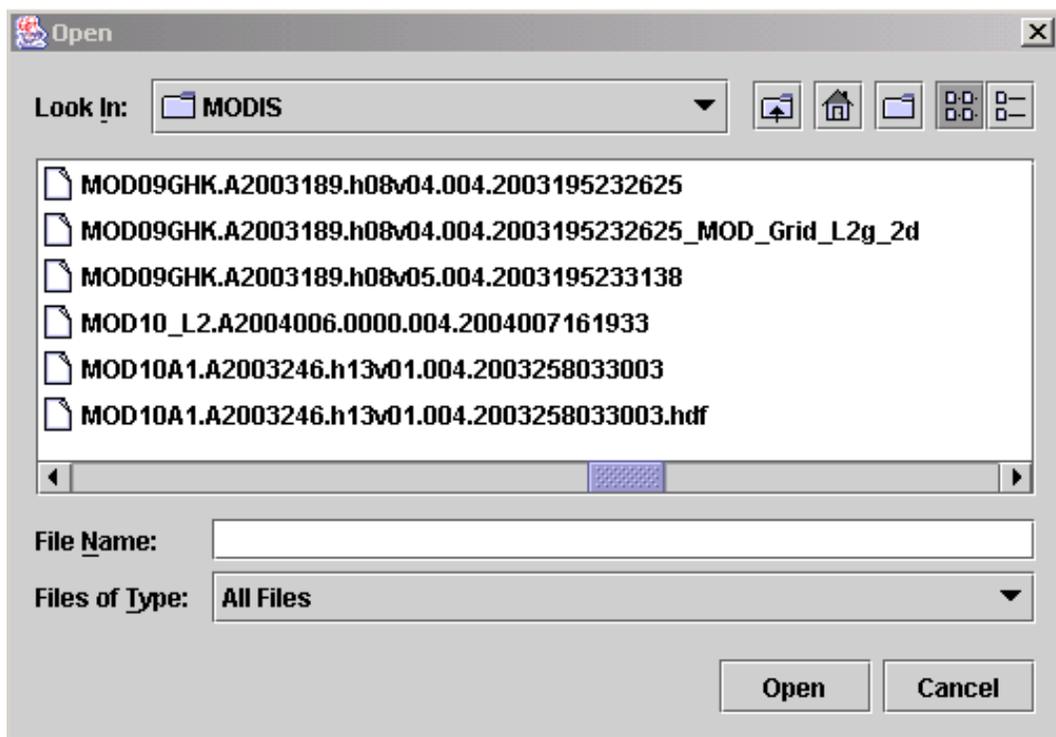


Figure 5-2. File Selection Window

The Tool menu option works as a toggle between the HEG GeoTiff Conversion and Stitch/Subset Tools. Selecting the option *Tool – Stitch/Subset* will cause the HEG Stitch/Subset Tool Window (Figure 5-5) to appear. The stitch/subset tool portion of the HEG is described in detail in section 5.2.

The Help menu option allows for the user to display a help window. Selecting *Help – User Help* will pop up a help window.

Left Panel

If the user selects a valid HDF-EOS file containing either Swath or Grid objects the file name will appear next to the button labeled “Input File.” This field is a text field and cannot be edited. The only way to open a different file is by use of the menu bar. Pressing the “Input File” button will cause a dialog to pop-up containing the full path and file name of the selected input file. This is provided as a convenience function to allow the user to view the entire file/path name of the selected input file.

The list of objects (swath and/or grid) contained in the selected HDF-EOS file will appear in the combo box labeled “Objects”. The user may select any object in the combo box by clicking on the box and clicking on the desired object. Selection of a new object will change text in most of the other fields. This will become self-explanatory as the remaining widgets are described.

The fields list, labeled by the text “Fields,” lists all the fields in the selected object. The user may select a field to be converted to a desired format by clicking on a field and pressing the select button. The select button is labeled with a down arrow. Pressing the select button will cause the highlighted field to move to the list labeled as “Selected.” To deselect a field the user would highlight the field to be de-selected in the “Selected” list and press the deselect button. The deselect button is labeled with an up arrow. Pressing the deselect button would cause the desired field to be returned to the fields list. Some objects will allow multiple field selections.

If the current object contains 3 or more dimensions, the third dimension desired may be entered into the text field labeled “Band”. The user may also put multiple GeoTIFF images in the same file by using “Multi-Band GeoTIFF” option in the combo box labeled “Output File Type” in the central panel (see below). If the current object contains 4 dimensions the user may enter the desired 4th dimension dataset to be converted in the field labeled “4th Dim”. The user can determine which dimension in the dataset is considered 3rd or 4th by checking the text in the “Object Info” text field.

For some objects spatial subsetting is available. If the combo box labeled “Spatial Subset:” is sensitized the user may pick between two options, “Lat-Long” or “Rows-Columns.” The text fields labeled “UL Corner:” and “LR Corner:” allows the user to adjust the upper-left and lower-right corners of the selected output file. For most objects the user will only be allowed to enter Latitude and Longitude values in these fields. There are some objects (i.e. MODIS Grid) that will allow the user to enter the number of rows and columns to use in the conversion.

Center Panel

The upper most widget in the center panel is the button labeled “Object Info”. This window contains information about the selected object. For example, if the selected object is a grid the window will contain the projection type, projection parameters, pixel size, etc. For all objects the window will contain all fields, field names, data type, etc. applicable to that object. The user should look at these values since they are used as defaults. Pressing the “Object Info” button

will cause a window to appear with all the object information in it. This window may be sized and moved as the user desires. Pressing the “Close” button will close the window.

The output file name will appear in the text field labeled “Output File Name”. This field is filled with a default once a field is selected. This field is editable so the user may just type in the file name as desired. This may also be edited by pressing the “Browse” button. Pressing the browse button will cause a file selection window (Figure 5-2) to appear. The user may peruse through the directory structure and type in the file name as desired. This directory and file name will then appear in the output file name field. The output file name must end in .tif for a GeoTIFF file, .bin for a non-standard Binary file, or .hdf for an HDF-EOS file.

For most objects the user may select what output file type they desire. The options are GeoTIFF, Binary, HDF-EOS, Multi-Band GeoTIFF or Multi-Band HDF-EOS. This action is performed by pressing on the combo box labeled “Output File Type”. Once the user selects the output file type, the file extension will be automatically changed in the text field labeled “Output File Name.”

If Multi-Band GeoTIFF is selected, then user can put more bands in the same geoTIFF file. This can be done after selecting X and Y Pixel sizes for the output (if the field is sensitized) and pressing “Accept” Button. User then can select another field or band and push “Accept” button again. All the chosen bands will be shown in the right panel in the text field labeled “Accepted List.” Please note that for Multi-Band Geotiff all fields or bands must have the same dimensions. Therefore, if user selects a field or band that has different dimensions than the first selected field, the “HEG Error” window will pop up reminding the problem.

Multi-Band HDF-EOS in principle, works the same as Multi-Band GeoTIFF except all the selected bands are placed in the same object of an HDF-EOS data set.

Some objects (e.g. MODIS Grid) allow the user three different types of resampling. They are Bilinear, Nearest Neighbor, and Cubic Convolution. This option may be made by pressing on the combo box labeled “Resampling Type”. For other objects such as MODIS swath only Nearest Neighbor resampling is available at this time.

The output projection type may be selected for some objects (Grid/Swath). With version 2.9, the options are: Geographic (GEO), Albers Conical Equal Area (Albers), Polar Stereographic (PS), Universal Transverse Mercator (UTM), Transverse Mercator (TM), Mercator (MER) , Lambert Azimuthal (LA), Lambert Conformal Conic (LCC), Sinusoidal (SIN), State Plane (STP), and No Reprojection (NO_REPROJECTION). This option may be selected by pressing on the combo box labeled “Output Projection.”

The Subsample (yes/no) button will allow the user to perform subsampling and specify the Start and Stride Values for X and Y through a Subsampling Dialogue Window. (See Figure 5-3).

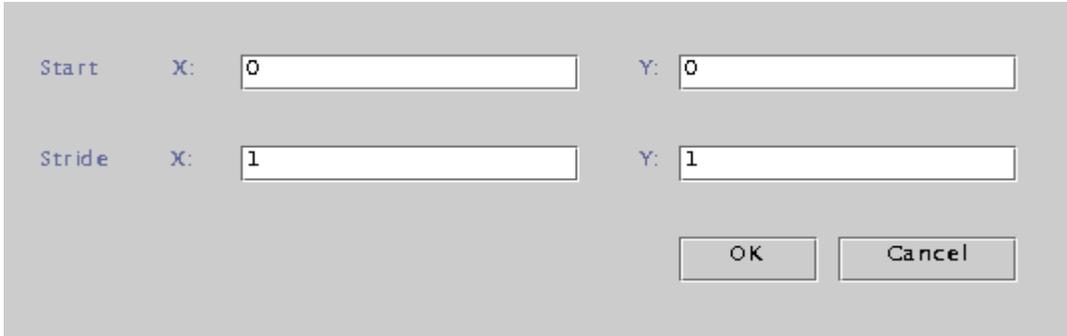


Figure 5-3. Subsampling Dialogue Window

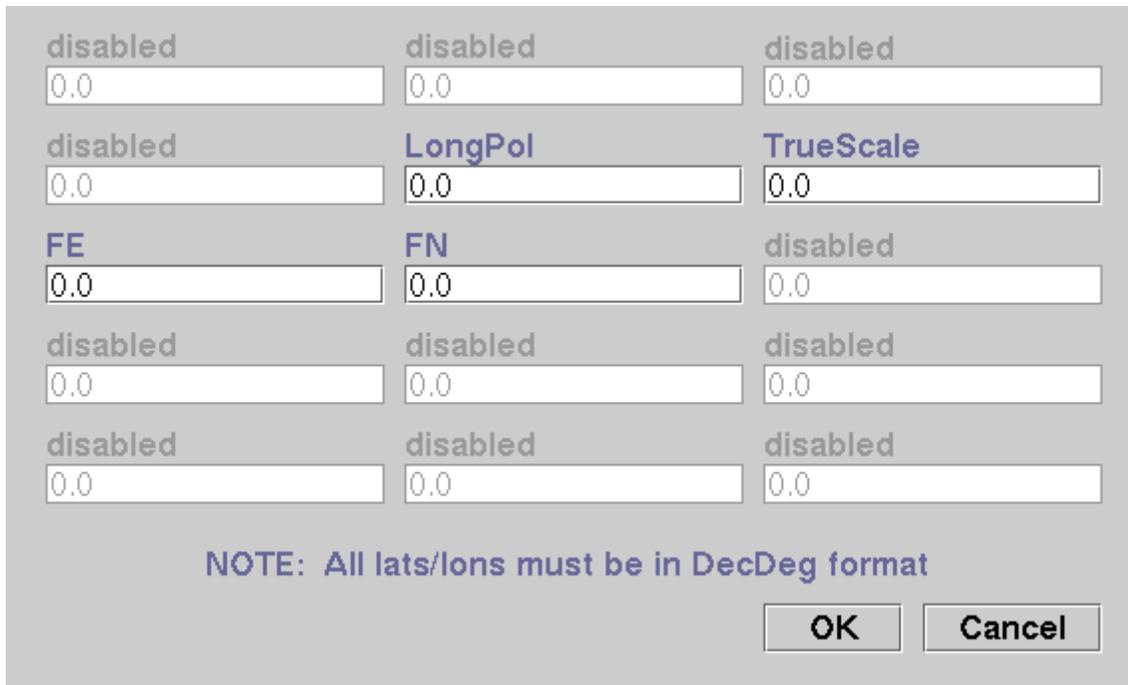


Figure 5-4. HEG Projection Parameters Window

Pressing the “Edit Parameters” button allows the user to edit the projection parameters. Pressing the edit parameters button will cause the HEG Projection Parameters Window (Figure 5-4) to appear.

The user may fill out the output projection parameters as desired or accept the default. The default output parameters will always be 0.0. Different parameters will be sensitized and desensitized based upon which output projection type the user has selected. This window will

also allow the user to select the UTM Zone and Ellipsoid Code if the user has selected UTM as the output projection.

Pressing the “SP Zone” button allows the user to select the State Plane Zone. This button is only activated if the user selects State Plane as the output projection. The user will be forced to select a zone since HEG does not assign a default. Pressing the “SP Zone” button will cause a dialog to appear displaying the possible zones that the user may select. See Appendix B for list of State Plane zones available to HEG.

For output grid objects the user has the option of setting the pixel size. The default pixel size will be listed in the “Object Info:” text box. The user may adjust that size by entering the desired size in either the text field labeled “Pixel Size X:” or “Y:” Please note that for Geographic projection the pixel size unit is decimal degrees while for other projections the unit is meters.

Once the user has all the desired output options selected the “Accept” button should be pressed. This will cause all the input options to be saved and the object and field name to be listed in the “Accepted List.” The user may select another object and/or field for conversion to allow batch conversions to take place.

If the user is creating a Multi-Band GeoTIFF file, then all items in the Accepted list will be placed into one GeoTIFF file as multiple bands. Different fields from different objects can be selected. All the items selected must be of the same dimension sizes. If this is not the case, then an error box will pop up and warn the user.

Right Panel

The right panel deals with output selections after the user has selected all the desired inputs. A list of desired outputs will appear in the text field labeled “Accepted List.” The items in this list are removed from the list by pressing the “Remove” button. The entire list can be removed all at once by pressing the “Clear” button. The user may select to save the parameter files but not run the conversions by pressing the “Save” button. This will cause a file selection window to appear (Figure 5-2). The user will select the directory and type in the name of a parameter file. The items in the accepted list will then be removed.

To perform the conversions as selected the user would simply press the “Run” button. This will cause all items in the accepted list to be converted and the list to be removed. During conversions a status window will appear giving an update on the conversion.

5.2 HDF-EOS Stitch/Subset Window

The HEG HDF-EOS Stitch/Subset Window (Figure 5-5) allows the user to stitch together and/or subset common datasets. It must be noted that the Stitch/Subset tool will only stitch or subset objects that have the same name and the same field name. The names must match exactly (it is case sensitive).

The window is divided into 4 basic sections: menu bar, left panel, center panel, and right panel.

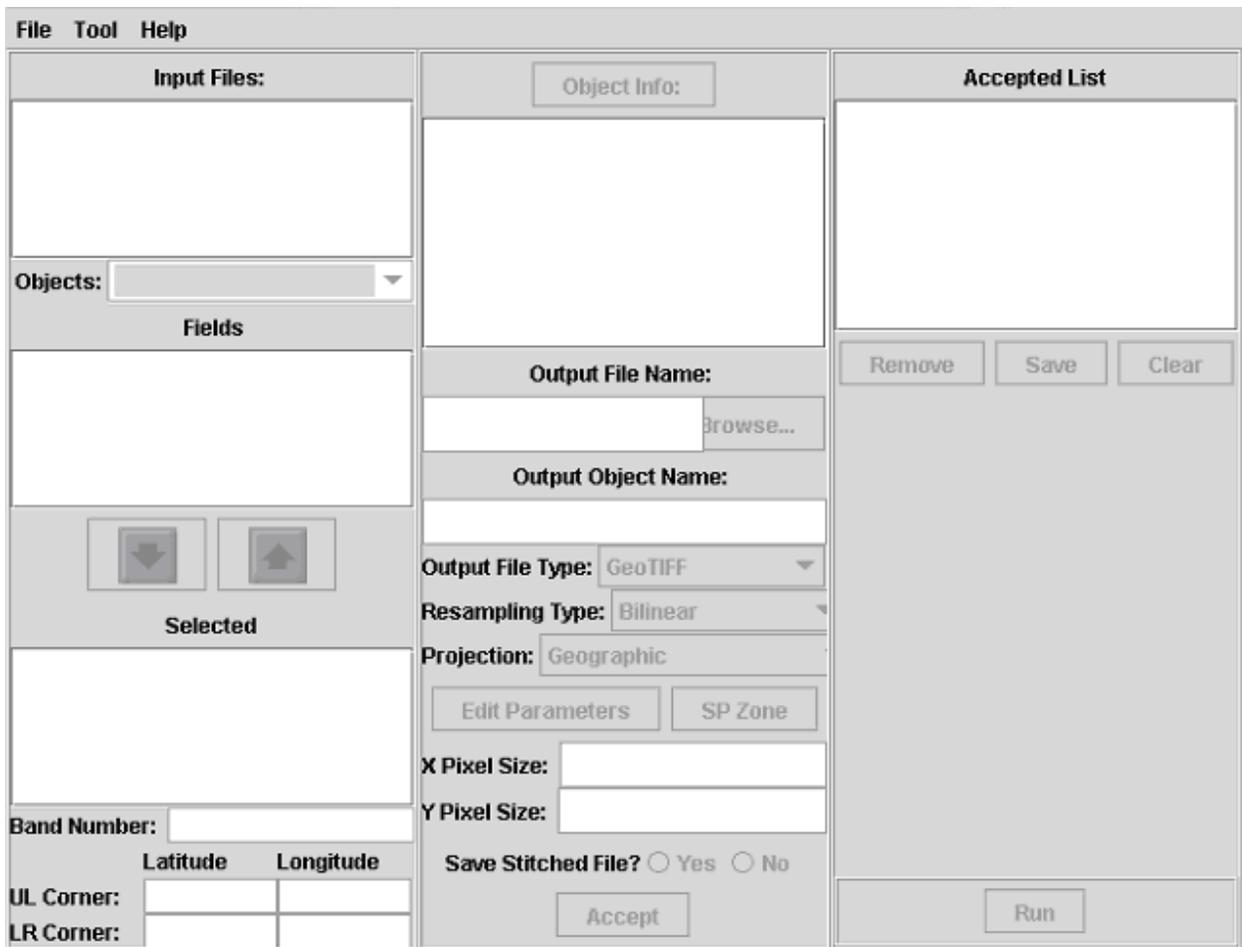


Figure 5-5. HEG HDF-EOS Stitch/Subset Window

Menu Bar

The menu bar on the Stitch/Subset window contains three options File, Tool, and Help.

The File menu bar option allows the user to open an HDF-EOS file, clear all input files, or exit the HEG tool. To open an HDF-EOS file the user will click on *File – Open*. A file selection window (Figure 5-2) would appear allowing the user to browse through the directory structure and pick the desired HDF-EOS file for viewing. If the user wishes to clear all files from the input file list and start a new stitch/subset session the *File – Clear* options would remove all files from the Input Files list. To exit the HEG tool the user would select *File – Exit*, which would cause the HEG GUI to close.

The Tool menu option works as a toggle between the HEG GeoTIFF Conversion and Stitch/Subset Tools. Selecting the option *Tool – GeoTIFF Convert* will cause the HEG GeoTIFF Conversion Tool Window to appear.

The Help menu option allows for the user to display a help window. Selecting *Help – User Help* will pop up a help window.

Left Panel

The “Input Files:” text field lists the files that are open and may be stitched and/or subsetted. Once again, when the files are open, the list of objects and fields that appear in the lists have already been checked to match exactly the objects and fields in the previously opened files. If the user opens a file that has no matches with the currently opened files a warning will appear and the file name will not appear in the input files list.

The “Objects:” combo box will list all the common objects in the open file(s). The user may change the object by clicking on the combo box and selecting the desired object.

The fields list, labeled by the text “Fields,” lists all the fields in the selected object. The user may select a field to be stitched and/or subsetted by clicking on a field and pressing the select button. The select button is labeled with a down arrow. Pressing the select button will cause the selected field to move to the list labeled as “Selected.” To deselect a field the user would highlight the field to be de-selected in the “Selected” list and press the deselect button. The deselect button is labeled with an up arrow. Pressing the deselect button would cause the desired field to be returned to the fields list.

Once a field has been selected some widgets will be sensitized based on the type of object that has been selected. The “Band Number:” field will allow the user to select which band of a field to perform an action on. This will be sensitized in cases where a field has more than two dimensions.

The corner points of the new file are set in the fields labeled “UL Corner” and “LR Corner”. This will contain the maximum sized dataset that is capable of being made based on all the files currently opened. The user may adjust this at their preference for subsetting.

Center Panel

The upper most widget in the center panel is the button labeled “Object Info”. This window contains information about the selected object. For example, if the selected object is a grid the window will contain the projection type, projection parameters, pixel size, etc. For all objects the window will contain all fields, field names, data type, etc. applicable to that object. The user should look at these values since they are used as defaults. Pressing the “Object Info” button will cause a window to appear with all the object information in it. This window may be sized and moved as the user desires. Pressing the “Close” button will close the window.

The output file name will appear in the text field labeled “Output File Name”. This field is filled with a default value once a field is selected. This field is editable so the user may type in the file name as desired. This may also be edited by pressing the “Browse” button. Pressing the browse button will cause a file selection window (Figure 5-2) to appear. The user may peruse the directory structure and type in the file name as desired. This directory and file name will then appear in the output file name field. The output file name must end in .bin for a non-standard Binary file or .hdf for an HDF-EOS file.

The user has the opportunity to set the name of the new object being created in the new stitched and/or subsetted file. This may be performed by editing the text in the text field labeled “Output Object Name”. This field is filled in with a default value upon field selection.

The user may select what output file type they desire. The options are GeoTIFF, Binary, or HDF-EOS. This may be performed by pressing on the combo box labeled “Output File Type”.

As in the Conversion Tool, user has the opportunity to choose the output projection type, and type of resampling (currently only Nearest Neighbour NN is available). Once the projection type is selected user has the opportunity to modify projection parameter values by clicking on “Edit Parameters” button and/or “SP Zone” button if State Plane projection is selected for output.

The user can specify the granularity by setting the pixel sizes in the fields labeled “X Pixel Size” and “Y Pixel Size”.

The Stitch/Subset tool creates a master file before it creates the user-requested file. This file is in the HDF-EOS format and may be saved per the user request. To ensure that the master HDF-EOS file is saved the user must press the “Yes” radio button next to the “Save Stitched File?” text field. Pressing the “No” radio button will cause the file to be deleted upon completion of the stitch/subset operation.

Once the user has all the desired output options selected the “Accept” button should be pressed. This will cause all the input options to be saved and the object and field name to be listed in the “Accepted List.” The user may select another object and/or field for conversion to allow batch conversions to take place.

Right Panel

The right panel deals with output selections after the user has selected all the desired inputs. A list of desired outputs will appear in the text field labeled “Accepted List.” The items in this list may be selected to be removed from the list by pressing the “Remove” button. The entire list can be removed all at once by pressing the “Clear” button. The user may select to save the parameter files but not run the stitch/subsets by pressing the “Save” button. This will cause a file selection window to appear (Figure 5-2). The user will select the directory and type in the name of a parameter file. The items in the accepted list will then be removed.

To perform the stitch/subsets as selected the user would simply press the “Run” button. This will cause all items in the accepted list to be run and the list to be removed. During the creation of the new stitch/subset field status window will appear giving an update on the run.

5.3 Examples of Usage

The conversion of a HDF_EOS Grid or Swath object to GeoTIFF, or non-standard binary, or to another HDF-EOS Grid is straightforward. An example of converting each type of object will be provided in this section.

5.3.1 Grid Conversion

After completing the download and install instructions provided in Section 4, the user should have successfully started the HEG tool. The main GeoTIFF conversion window (shown in Figure 5-1) will appear.

The first step to converting a Grid object will be to select a file for opening. Selecting a file is performed by selecting *File – Open* from the menu bar. This will cause the file selection window (Figure 5-2) to appear. The user has the ability to move through the directory structure as desired. Once the desired file is found, click on that file and press *Open* button. This will cause the desired file to be opened and the information regarding that file to be placed in the proper fields of the HEG GeoTIFF Conversion window. In the case of this example, the file

MOD09GHK.A2000238.h20v11.001.2000253195532.hdf is selected and opened. This is a MODIS file containing a grid named MOD_Grid_L2g_2d.

The grid MOD_Grid_L2g_2d will now appear in the objects combo box (Figure 5-6). Pressing down the down arrow button will cause all objects in the file to be listed. The user may click on the desired object at this point



Figure 5-6. Objects Combo Box

Since our example file contains only one grid, only one object appears in the objects list.

The grid that we have selected contains 10 fields. All of these fields will appear in the fields list (Figure 5-7).

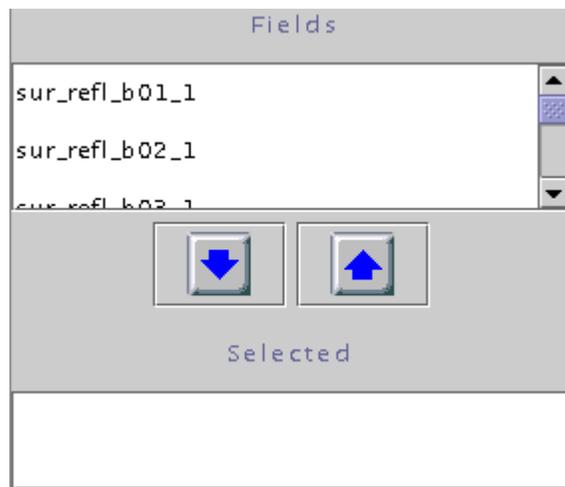
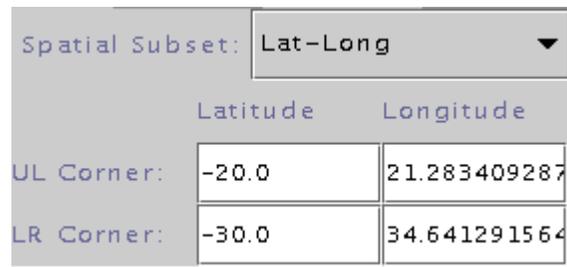


Figure 5-7. Fields List

The user may select a field for conversion by selecting a field name and pressing the select button. The select button is marked with a down arrow. The field name will then move to the selected field list. Once a field has been selected many other areas of the GUI will become sensitized, or available for user input.

All necessary inputs will now be filled in with defaults and the “Accept” button may be pressed. In the case that the user will want to modify the default values, the next step in the conversion process would be to select the geographical area in the file for conversion. This is done at the bottom of the left panel in the “Spatial Subset” area. In the case of this example, the Spatial Subset combo box is available for selection. The user may use this box to toggle between “Lat-Long” and “Rows-Columns.” This combo box will not be sensitized for any other data except for MODIS grid data.

This next step in the process will be to enter the proper coordinates in the coordinate boxes. (Figure 5-8)



	Latitude	Longitude
UL Corner:	-20.0	21.283409287
LR Corner:	-30.0	34.641291564

Figure 5-8. Spatial Subset Area

The default values provided in the subset area provide the largest image possible from the selected grid. These values may be edited to create a smaller image from the selected grid.

The next step in the process would be to select the output file name desired by the user. In the center panel below the text field labeled “Output File Name:” is a text field containing the default file name. This field is editable or the user may want to click on the “Browse...” button, which will open a file selection window. The user may then peruse through the directories and enter the desired file name. Selecting “Save” in the chooser window will cause the selected file name to appear in the output file text field.

The user may alter the output type by selecting the “Output File Type:” combo box. There are four options for output file type: GeoTIFF, Binary, HDF-EOS, Multi-Band GeoTIFF or Multi-Band HDF-EOS.

The user may alter the resampling type by selecting the “Resampling Type:” combo box. There are three options for resampling type: Bilinear, Nearest Neighbor, or Cubic Convolution.

The user may alter the output projection by selecting the “Output Projection:” combo box. The options for output projection are Geographic, Polar Stereographic, UTM, Mercator, Transverse Mercator, Lambert Azimuthal, Lambert Conformal Conic, Sinusoidal, State Plane, or No

Reprojection (if output grid is desired to have the same projection as the input grid). The next step in the conversion process would be to ensure that the proper projection parameters are entered. Pressing on the “Edit Parameters” button would perform entering the projection parameters. Pressing this button will cause the Edit Parameters window (Figure 5-4) to appear. All parameters will be 0.0 unless edited by the user. If the user selected the State Plane projection, the “SP Zone” button will need to be pressed and a zone will need to be selected in the “State Plane Zones” dialog (see Appendix B for a list of available state plane zones). State Plane should only be selected for data that is located in the United States.

The subsampling (yes/no) button will activate the subsampling input dialogue box if the user presses “yes”. The default is “no”. Start and Stride in the X and Y direction are entered in the Subsampling Dialogue Window (Figure 5-3).

The user may wish to specify an X and/or Y pixel size for the output grid. The default pixel size is shown in the “Object Info” text area. This value is in input projection units. For our example the default value is 463.31 meters. If no values are entered into these fields the default values will be converted to the output projection type units and used in the conversion. If values are entered into these fields they will be used as is. No conversions will be performed on them.

Once the user has selected the desired input parameters for file conversion the next step is to press the “Accept” button. This will place the selection into the “Accepted List” of items that is ready for conversion. These conversions may be from multiple files, swath and grid intermixed, and different output types. The items will remain in this list until they are removed, saved to a parameter file or the conversion is run.

If the user is creating a Multi-Band GeoTIFF file, then all the objects in the “Accepted List” must be of the output file type: Multi-Band GeoTIFF. If not, an error window will warn the user. Also, all the objects must be of the same dimensions. Different fields from different objects are allowed. The same is true for Multi-Band HDF-EOS.

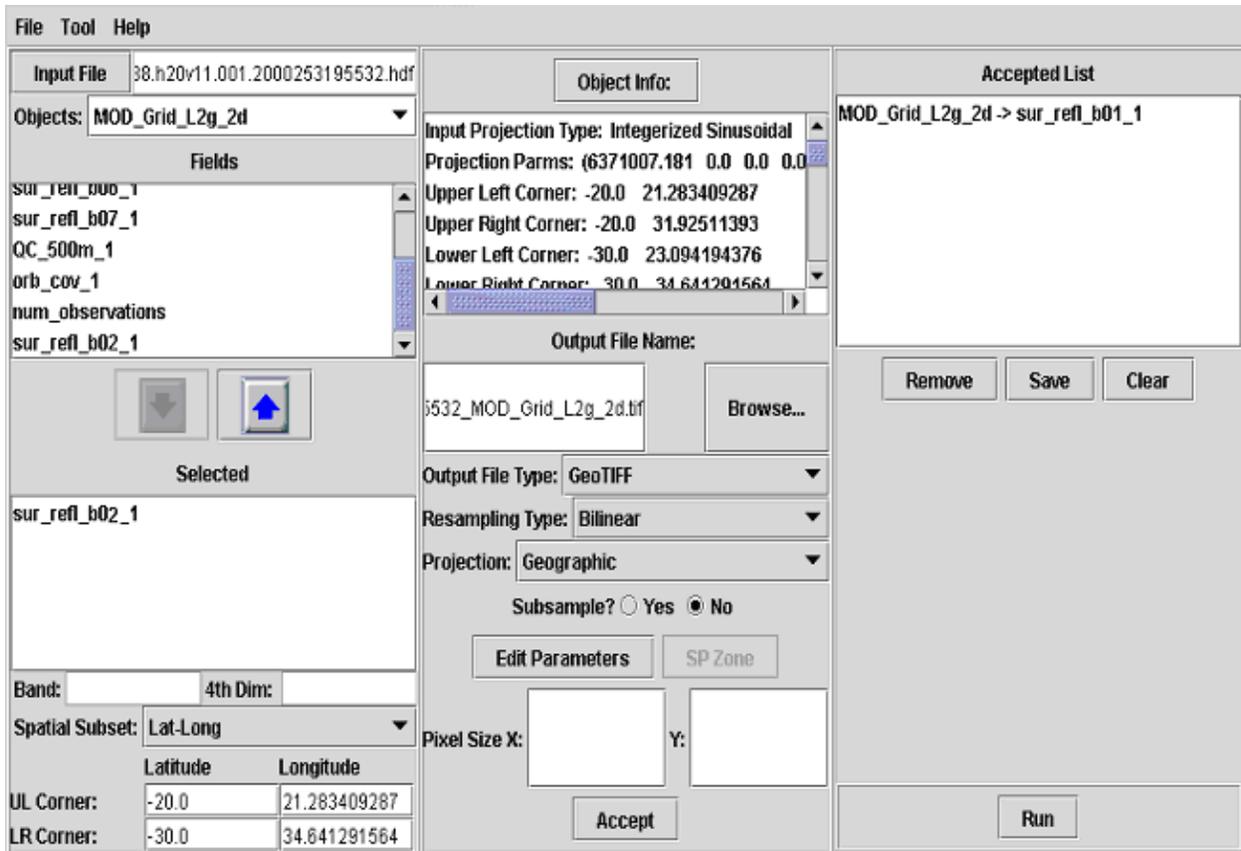


Figure 5-9. GeoTIFF Conversion Window Containing Example

As shown in Figure 5-9 the user has entered a second selection for conversion and may now press the Accept button. Items in the Accepted List are ready for conversion. It is possible that the user has decided to not perform one or all of the conversions in the list. Items may be removed one of two ways; the first way will be to highlight an item and press the “Remove” button. This would remove only the selected item. The second way will be to press the “Clear” button. This will remove all items from the accepted list.

In most cases the next step would be to perform the conversions. The easiest way to perform this is to press the “Run” button. This will cause all conversions listed in the accepted list to be performed. The user may choose to perform the conversions manually at the command line. To perform the conversions manually, or at the command line, the user would need to press the “Save” button. Pressing the save button will cause a file selection window to appear. The user enters the name of the desired parameter file and the items in the list will be written to the designated parameter file. This file can then be used as input into the proper conversion program. Running the conversion programs from the command line is described in detail in Section 7.

5.3.2 Swath Conversion

The first step to converting a swath object would be to select a file for opening. To select a file to open the user would select *File – Open* from the menu bar. This will cause the file selection window (Figure 5-2) to appear. The user has the ability to move through the directory structure as desired. Once the desired file is found, click on that file and press the *Open* button. This will cause the desired file to be opened and the information regarding that file to be placed in the proper fields of the HEG GeoTIFF Conversion window (see Figure 5-10). In the case of this example, the AST_L1B file pg-PR1B000-2000080702_241_001.hdf will be selected and opened. This is an ASTER file containing three swaths named VNIR_Swath, SWIR_Swath, and TIR_Swath.

For our example we have selected the swath VNIR_Swath. Therefore, the swath VNIR_Swath will now appear in the objects combo box. The user may press the down arrow button to cause all objects in the file to be listed. The user may click on the desired object at this point.

The next step for swath conversion would be to select the desired field to be converted. The swath VNIR_Swath contains four fields. These fields will be listed in the Fields list. The user may pick a field by clicking on the field and pressing the select button. The select button is marked with a down arrow. The selected field in the example, “ImageData2”, is now in the Selected fields list. Once a field has been selected other areas on the window will now become available for input.

Now that the user has selected a field, all fields that the user may enter as parameters will be filled in with default values. The user may press the “Accept” button and perform the conversion as is or alter the default values.

The next step in our example will be to set the geographical size of the image to be created. The default values provided in the “Latitude” and “Longitude” text fields will create the largest image that can possibly be created with the selected swath. These values may be edited to create a smaller image from the selected swath.

The next step in the process would be to select the output file name desired by the user. In the center panel below the text field labeled “Output File Name:” is a text field containing the default file name. This field is editable or the user may want to click on the “Browse...” button, which will open a file selection window. The user may then peruse through the directories and enter the desired file name. Selecting “Save” in the chooser window will cause the selected file name to appear in the output file text field.

The user may alter the output type by selecting the “Output File Type:” combo box. There are four options for output file type: GeoTIFF, Binary, HDF-EOS, Multi-Band GeoTIFF, or Multi-Band HDF-EOS.

Since currently only Nearest Neighbor resampling type is available to users, we cannot change the default resampling type.

The user may alter the output projection by selecting the “Output Projection:” combo box. The options for output projection are Geographic, Albers Conical Equal Area, Polar Stereographic,

UTM, Mercator, Transverse Mercator, Lambert Azimuthal, Lambert Conformal Conic, Sinusoidal, State Plane, or No Reprojection. The No Reprojection option is valid only for ASTER L1B data where the swath is projected to a satellite path oriented UTM grid. The next step in the conversion process would be to ensure that the proper projection parameters are entered. Pressing on the “Edit Parameters” button would perform entering the projection parameters. Pressing this button will cause the Edit Parameters window (Figure 5-4) to appear. All parameters will be 0.0 unless edited by the user. If the user selected the State Plane projection, the “SP Zone” button will need to be pressed and a zone will need to be selected in the “State Plane Zones” dialog (see Appendix B for a list of available state plane zones). State Plane should only be selected for data that is located in the United States.

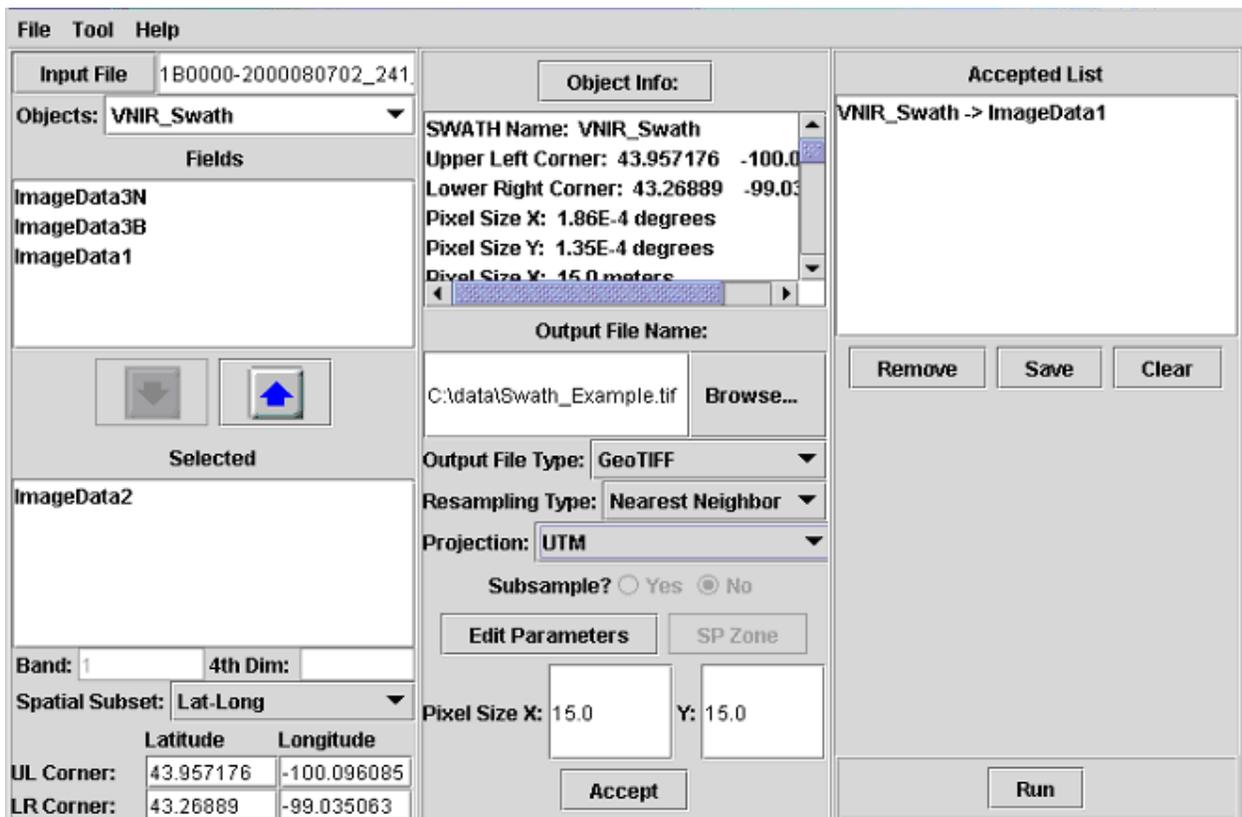


Figure 5-10. Swath Example

Once the user has selected the desired input parameters for file conversion the next step is to press the “Accept” button. This will place the selection into the “Accepted List” of items that is ready for conversion. These conversions may be from multiple files, and different output types, but the objects should be either swath or grid. The items will remain in this list until they are removed, saved to a parameter file or the conversion is run.

As shown in Figure 5-10 the user has entered a selection for conversion and may now press the Accept button. Items in the Accepted List are ready for conversion. It is possible that the user

has decided to not perform one or all of the conversions in the list. Items may be removed one of two ways; the first way would be to highlight an item and press the “Remove” button. This would remove only the selected item. The second way would be to press the “Clear” button. This would remove all items from the accepted list.

In most cases the next step would be to perform the conversions. The easiest way to perform this is the press the “Run” button. This will cause all conversions listed in the accepted list to be performed. The user may choose to perform the conversions manually at the command line. To perform the conversions manually, or at the command line, the user would need to press the “Save” button. Pressing the save button will cause a file selection window to appear. The user enters the name of the desired parameter file and the items in the list will be written to the designated parameter file. This file can then be used as input into the proper conversion program. Running the conversion programs from the command line is described in detail in Section 7.

5.3.3 HEG Stitch/Subset Tool Examples

HEG can perform stitching and/or subsetting of like datasets. Like datasets are defined as those having the same object name (swath name or grid name) and the same field name. The user may use this tool to make a dataset smaller or to combine datasets from multiple files. HEG will write the new dataset to either GeoTIFF or HDF-EOS or to non-standard binary. The following sections provide examples of stitching and subsetting datasets.

The Stitch/Subset GUI is similar to the GeoTIFF Conversion GUI. This will help the user to easily perform the conversion or combining of HDF-EOS files to the desired size and type of file.

5.3.4 Grid Stitch/Subset

The first step in stitching and/or subsetting HDF-EOS files is to open the selected file(s). Opening an HDF-EOS file is performed by pressing the File – Open option on the menu bar. This will cause a file selection to appear. The user may browse through the file structure and pick the desired file. Pressing the “Open” button in the file selection window will cause this file to be opened. The file name will appear in the “Input Files:” list. If the user wishes to stitch multiple files the above process would be repeated for each file. If the user opens a file which does not have a matching object name and field name, a warning will appear and the file will not appear in the input files list.

The warning may only appear when at least one file has already been opened for processing. The next file opened is compared to the last file on the list for matches. For this example, the



Figure 5-11. No Match Warning

Files MOD09A1.A2001065.h28v04.003.2001190021128.hdf and MOD09A1.A2001065.h28v05.003.2001190024429.hdf will be used. These files contain a MODIS grid named MOD_Grid_500m_Surface_Reflectance.

The objects combo box will list the objects that are common to all the currently opened files. The user may select a different object by pressing on the combo box and the complete list of objects will appear.

Once an object is selected the fields associated with that object will appear in the “Fields” list. This is the list of fields that may be selected for processing. The user may pick a field by clicking on the field and pressing the select button. The select button is marked with a down arrow. The selected field in the example, “sur_refl_b01”, is now in the “Selected” fields list. Once a field has been selected, other areas on the window will now become available for input.

Now that the user has selected a field all fields that the user may enter as parameters will be filled in with default values. The user may press the “Accept” button and perform the conversion as is or alter the default values.

If the selected field has 3 dimensions the “Band Number:” field will be available for input. The default value is 1. The user may enter a number not greater than the number listed as “Num Bands:” in the “Object Info:” window for the selected field.

The next step in the process of creating a new object would be to determine the geographical area of the new object being created. The largest possible area will be listed in the “Latitude” and “Longitude” fields. These coordinates will represent the largest land area an object can be by combining all the grids (in this example) into a single object. The user may edit these values to customize the size of the area covered.

The next step in the process will be to select the output file name desired by the user. In the center panel below the text field labeled “Output File Name:” is a text field containing the default file name. This field is editable or the user may want to click on the “Browse...” button, which will open a file selection window. The user may then peruse through the directories and enter the desired file name. Selecting “Save” in the chooser window will cause the selected file name to appear in the output file text field.

The user may specify the name of the newly created object. This is performed by editing the text in the field marked “Output Object Name”.

The user may select the file type by pressing the “Output File Type:” combo box. The options will be GeoTIFF, Hdf-Eos or Binary.

User may choose any of the supported projections as explained in the grid/swath conversion example.

Here we have selected UTM. The UTM zone code will be evaluated by hegtool and put in the parameter file.

The next step in the process is to set the pixel size. The output grid will be written at the same granularity of the input grid, if the fields marked “X Pixel Size” and “Y Pixel Size” are left blank. The input pixel size will be listed in the “Object Info” field.

To create the specified file the stitch/subset tool will create a master HDF-EOS file. The master HDF-EOS file will be used as input to create the user specified file. If the user desires to keep this master file they can press the “Yes” radio button labeled “Save Stitched File?”

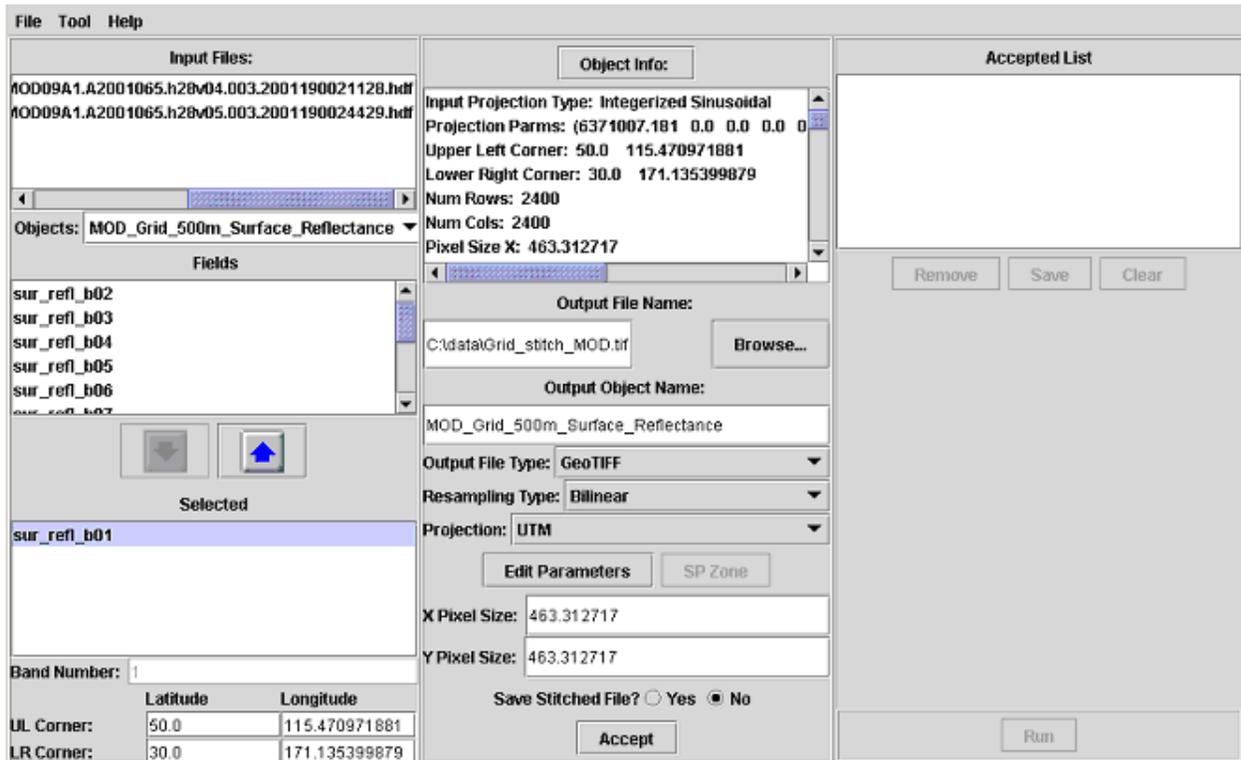


Figure 5-12. Grid Stitch/Subset Example

Once the user has selected the desired input parameters for new file stitch/subset creation the next step is to press the “Accept” button. This will place the selection into the “Accepted List” of items that is ready for creation. There may be multiple items in the list with varying inputs. The items will remain in this list until they are removed or the stitch/subset tool is run.

As shown in Figure 5-12 the user has entered a selection for stitch/subset and may now press the Accept button. Items in the Accepted List are ready for creation. It is possible that the user has decided to not perform one or all of the runs in the list. Items may be removed one of two ways. The first way will be to highlight an item and press the “Remove” button. This will remove only the selected item. The second way would be to press the “Clear” button. This will remove all items from the accepted list.

In most cases the next step would be to perform the conversions. This can be performed by pressing the “Run” button. This will cause all stitch/subset parameters listed in the accepted list to be performed.

5.3.5 Swath Stitch/Subset

The process of stitching and/or subsetting swath objects is identical to that of stitching or subsetting a grid object. (See Section 5.3.4)

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6. Software Architecture

6.1 HDF-EOS to GeoTIFF Conversion Tool

Figure 6.1 gives an overview of the HDF-EOS to GeoTIFF Conversion tool (HEG).

Module Descriptions

HEG GUI – The HEG GUI is actually a parameter file editor. It allows the user to open and display the contents of an HDF-EOS file in a readable format. The user may then pick the desired options and perform the conversion.

hegtool – The hegtool module opens and reads all the information needed from the HDF-EOS file. This information is written to a header file which is ingested in the graphical user interface.

resample – The resample module performs conversions on all non-MISR Grid objects.

gd.tif – Performs conversions on the MISR grid datasets.

sw.tif – Performs conversions on swath data.

subsample_grid – Performs subsampling on grid objects.

The HEG program is constructed so the user need not have knowledge about the type of object or instrument that created the data.

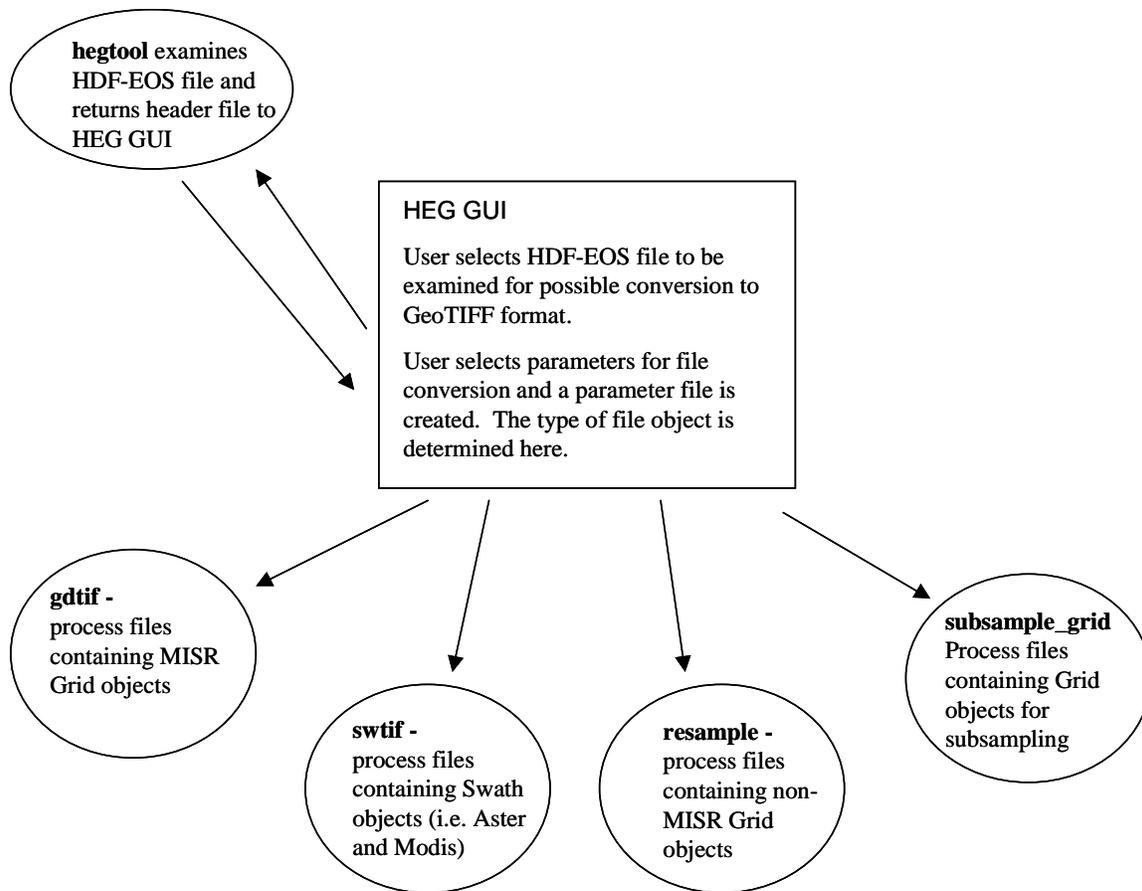


Figure 6-1. Overview of HEG Tool

6.2 HEG Subset/Stitch Tool

Figure 6-2 gives an overview of the HDF-EOS Subset/Stitch tool.

Module Descriptions

HEG GUI – The HEG GUI is actually a parameter file editor. It allows the user to open and display the contents of an HDF-EOS file in a readable format. The user may then pick the desired options and perform the conversion.

hegtool – The hegtool module opens and reads all the information needed from the HDF-EOS file. This information is written to a header file which is ingested in the graphical user interface.

subset_stitch_grid – Perform all subset and stitch operations on grid objects.

subset_stitch_swath – Perform all subset and stitch operations on swath objects.

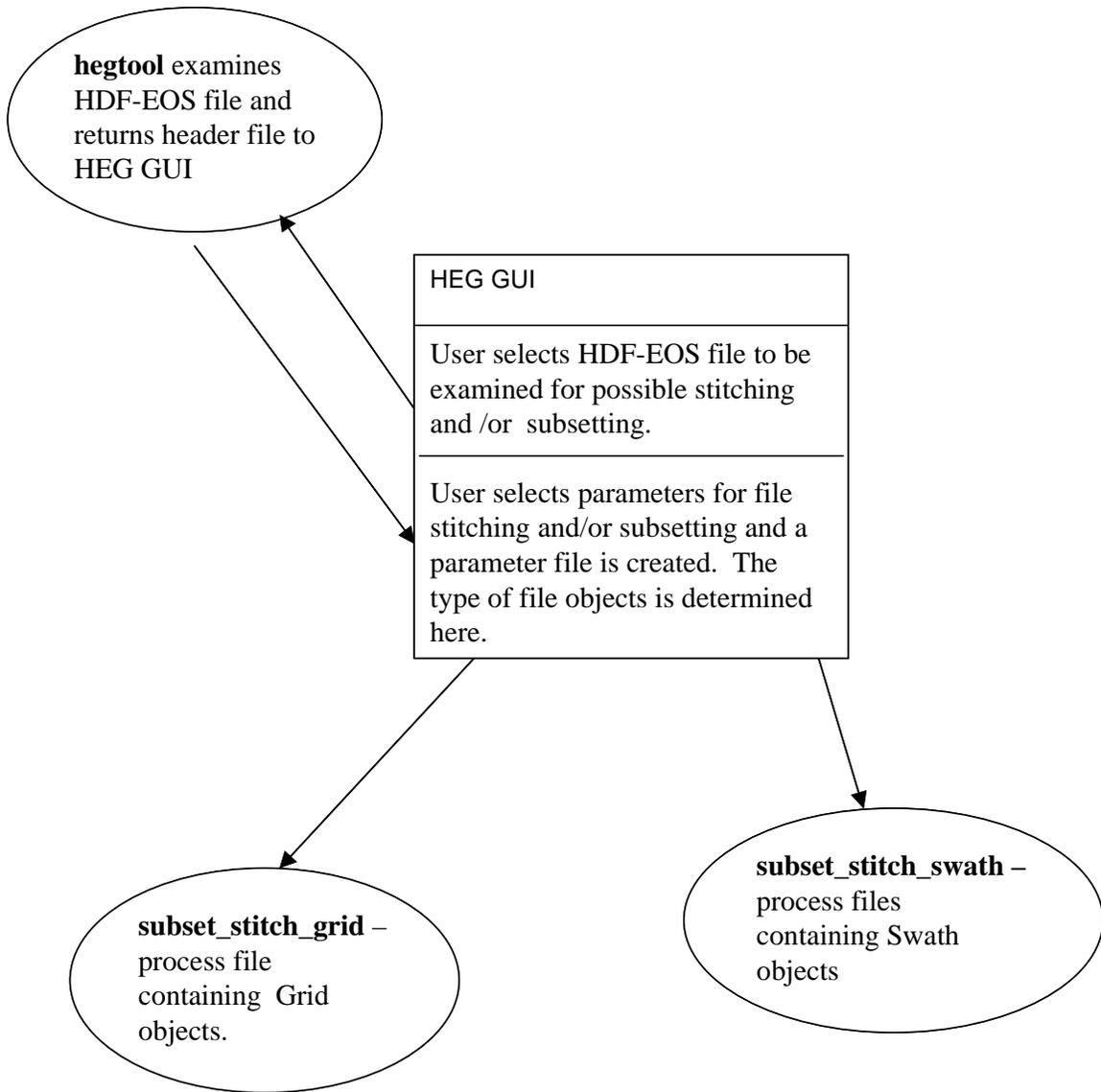


Figure 6-2. Overview of Stitch/Subset Function

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7. Command Line Interface

7.1 Introduction

The HEG tool is operable by either a GUI (Section 5) or by a command line interface. The GUI uses the command line interface by converting user input parameters such as bounding box latitude and longitude into a parameter file. Commands are then executed underneath the GUI. The user can also execute commands manually. In this case, parameter files will need to be built manually. This section describes the commands needed to execute the main functions described in Section 6. Also described are the contents of the parameter files required by the commands.

For proper handling of reading/writing metadata user must set environment variables “PGSHOME” and “MRTDATADIR” to the “TOOLKIT” and “data” directories in the “heg” directory respectively. This must be done prior to executing all tools described below so that they work correctly.

7.2 hegtool

The HDF-EOS to GeoTIFF Conversion tool (HEG) uses a tool called hegtool to determine the objects in an HDF-EOS file. Objects may be defined as Swaths or Grids. hegtool places the object information into a header file which is interpreted by the HEG graphical user interface (GUI).

7.2.1 hegtool Usage

The usage of the hegtool is by using the ‘-h’ flag. For example, if the file in which the user wants examined is named MOD09GHK.A2000238.h20v11.001.2000253195532.hdf then the command would be:

```
hegtool -h MOD09GHK.A2000238.h20v11.001.2000253195532.hdf
hegtool then produces the file named HegHdr.hdr.
```

Also one may specify the header file name using “-n” instead of “-h”:

```
hegtool -n MOD09GHK.A2000238.h20v11.001.2000253195532.hdf myhegHdr.hdr
```

If the input file is a MISR file, then hegtool also produces a file called HegMISRCoords.hdr. This file contains the upper-left and lower-right corner coordinates for the MISR blocks and the MISR block data flags.

7.2.2 Format of Header Files

The header file produced by hegtool is an ASCII file. The format is as follows:

STATUS_VALUE = status value

- If the status value is not zero (0) then there was an error retrieving information from the selected file. The header file should be closed and not used as a description of the selected HDF-EOS file.

FILE_NAME = input file name

- The input file name will be listed exactly as it was passed to the hegtool. If the full file path was present it will be listed here in the header file.

NUM_OBJECTS = number swaths + number grids

- The number of objects parameters will contain the total number of swaths and grids in the selected input file.

NUM_GRIDS = number grids

- The number of grids parameter will contain the total number of grids objects in the selected input file.

NUM_SWATHS = number swaths

- The number of swaths parameter will contain the total number of swath objects in the selected input file.

GRID_NAMES = grid names

- The grid names parameter will be a comma separated list of grid names. The names will be listed exactly as they appear in the input file.

GRID_PROJECTION_TYPE = projection types

- The grid projection types will contain a list of integers separated by spaces. The total number of integers will be equal to the number of grids in the file. The numbers will correspond to the mnemonics assigned a projection name in the GCTP library.

GRID_PROJECTION_PARAMETERS = p1 p2 p3 ... p15

- The grid projection parameters will list a series of fifteen (15) parameters for each grid in the input file. The parameters will be written three (3) per line and the line will end with the backslash symbol (\). The last line will not have the backslash, signifying the last line. The parameter values are a series of double values which appear exactly as they do in the selected input file.

GRID_UL_CORNER_LATLON = upper left lat/lon values

- The upper left and latitude and longitude values are listed in double values separated by a space.

GRID_UR_CORNER_LATLON = upper right lat/lon values

- The upper right and latitude and longitude values are listed in double values separated by a space.

GRID_LL_CORNER_LATLON = lower left lat/lon values

- The lower left and latitude and longitude values are listed in double values separated by a space.

GRID_LR_CORNER_LATLON = lower right lat/lon values

- The lower right and latitude and longitude values are listed in double values separated by a space.

GRID_NCOLUMNS = number of columns

- This parameter will list the number of entries in the x-dimension of the grids. The values are integers and are separated by a space.

GRID_NROWS = number of rows

- This parameter will list the number of entries in the y-dimension of the grids. The values are integers and are separated by a space.

GRID_PIXEL_SIZE = pixel size

- The pixel size will be a space separated list of double values. The pixel size will be the lesser of the pixel size in the x-dimension vs. the y-dimension.

GRID_PIXEL_SIZE_X = x-pixel size

- The x-pixel size will be a space separated list of double values. The pixel size will be in the units dictated by the input projection type.

GRID_PIXEL_SIZE_Y = y-pixel size

- The y-pixel size will be a space separated list of double values. The pixel size will be in the units dictated by the input projection type.

GRID_NFIELDS – number of fields

- The number of fields for each grid will be listed in a space separated list. The list will consist of integers.

GRID_FIELD_NAMES = field names

- A comma separated list of field names associated with the grids in the file.

GRID_DATA_TYPES = data types

- An integer list separated by spaces. The values will correspond to the standard HDF data types.

GRID_NUM_DIMS = number of dimensions

- The list of dimensions corresponds to the number of dimensions in each field of each grid.

GRID_NUM_BANDS = number field dimensions

- The number of field dimensions for a 3-D data set is listed in a space separated list.

GRID_4TH_DIM = number of dimensions in 4th dimension

- The number of field dimensions in the 4th dimension of a 4-D data set listed in a space separated list.

GRID_BAND_NAME = band names

- The names of the dimensions corresponding to the grid bands (or 3rd dimension) of a 3-D or 4-D dataset listed in a comma separated list. If the field does not contain 3 dimensions the value “-99” will appear in the list.

GRID_4TH_DIMNAME = 4th dimension names

- The names of the dimensions corresponding to the grid 4th dimension of a 4-D dataset listed in a comma separated list. . If the field does not contain 4 dimensions the value “-99” will appear in the list.

ASTER_FLAG = aster_flag

- If the file is ASTER L1B then the flag will be “YES”, otherwise it is “NO”

SWATH_NAMES = swath names

- The swath names parameter will be a comma separated list of swath names. The names will be listed exactly as they appear in the input file.

SWATH_NFIELDS = number of fields

- The number of fields for each swath will be listed in a space separated list. The list will consist of integers.

SWATH_FIELD_NAMES = field names

- A comma separated list of field names associated with the swaths in the file.

SWATH_NUM_DIMS = number of dimensions

- The list of dimensions corresponds to the number of dimensions in each field of each grid.

SWATH_NUM_BANDS = number field dimensions

- The number of field dimensions for a 3-D data set is listed in a space separated list.

SWATH_DIM_X_SIZE = x dimension sizes

- The size of the fields in the x dimension.

SWATH_DIM_Y_SIZE = y dimension sizes

- The size of the fields in the y dimension.

SWATH_DATA_TYPES = data types

- An integer list separated by spaces. The values will correspond to the standard HDF data types.

SWATH_LAT_MIN = latitude minimums

- The list of minimum latitudes for each swath. The list is a space separated list of double values.

SWATH_LAT_MAX = latitude maximums

- The list of maximum latitudes for each swath. The list is a space separated list of double values.

SWATH_LON_MIN = longitude minimums

- The list of minimum longitudes for each swath. The list is a space separated list of double values.

SWATH_LON_MAX = longitude maximums

- The list of maximum longitudes for each swath. The list is a space separated list of double values.

SWATH_X_PIXEL_RES_METERS = output x pixel size in meters

SWATH_XYPIXEL_RES_METERS = output y pixel size in meters

SWATH_X_PIXEL_RES_DEGREES = output x pixel size in decimal degrees

SWATH_Y_PIXEL_RES_DEGREES = output y pixel size in decimal degrees

7.2.3 An Example of a HegHdr.hdr File

This is an example of a completed header file created by hegtool on an HDF file that contains a Grid object.

```
STATUS_VALUE=0
```

```
FILE_NAME=/hdfdata/MOD09GHK.A2000238.h20v11.001.2000253195532.hdf
```

```
NUM_OBJECTS=1
```

```
NUM_GRIDS=1
```

```

NUM_SWATHS=0

GRID_NAMES=MOD_Grid_L2g_2d,

GRID_PROJECTION_TYPE=99

GRID_PROJECTION_PARAMETERS= \
    6371007.181000000  0.000000000  0.000000000 \
    0.000000000      0.000000000  0.000000000 \
    0.000000000      0.000000000  86400.000000000 \
    0.000000000      1.000000000  0.000000000 \
    0.000000000      0.000000000  0.000000000

GRID_UL_CORNER_LATLON=-20.000000000 21.283409287

GRID_UR_CORNER_LATLON=-20.000000000 31.925113930

GRID_LL_CORNER_LATLON=-30.000000000 23.094194376

GRID_LR_CORNER_LATLON=-30.000000000 34.641291564

GRID_NCOLUMNS=2400

GRID_NROWS=2400

GRID_PIXEL_SIZE=463.312717

GRID_PIXEL_SIZE_X=463.312717

GRID_PIXEL_SIZE_Y=463.312717

GRID_NFIELDS=10

GRID_FIELD_NAMES=sur_refl_b01_1,sur_refl_b02_1,sur_refl_b03_1,sur_
_refl_b04_1,sur_refl_b05_1,sur_refl_b06_1,sur_refl_b07_1,QC_500m_
1,orb_cov_1,num_observations,

GRID_DATA_TYPES=22 22 22 22 22 22 22 25 21 20

GRID_NUM_DIMS=2 2 2 2 2 2 2 2 2 2

GRID_NUM_BANDS=0 0 0 0 0 0 0 0 0 0

GRID_4TH_DIM=0 0 0 0 0 0 0 0 0 0

```

```
GRID_BAND_NAME=-99,-99,-99,-99,-99,-99,-99,-99,-99,-99,  
GRID_4TH_DIMNAME=-99,-99,-99,-99,-99,-99,-99,-99,-99,-99,
```

This is an example of a header file created by hegttool on an HDF file that contains swath objects

```
STATUS_VALUE=0  
FILE_NAME= /hdfdata/AST_L1B/pg-PR1B0000-2000080702_241_001.hdf  
NUM_OBJECTS=3  
NUM_GRIDS=0  
NUM_SWATHS=3  
ASTER_FLAG=YES  
  
SWATH_NAMES=VNIR_Swath,\  
SWIR_Swath,\  
TIR_Swath,  
  
SWATH_NFIELDS=4 \  
6 \  
5  
  
SWATH_FIELD_NAMES=ImageData1, ImageData2, ImageData3N, ImageData3B, \  
ImageData4, ImageData5, ImageData6, ImageData7, ImageData8, ImageData9  
, \  
ImageData10, ImageData11, ImageData12, ImageData13, ImageData14,  
  
SWATH_NUM_DIMS=2 2 2 2 \  
2 2 2 2 2 2 \  
2 2 2 2 2  
  
SWATH_NUM_BANDS=1 1 1 1 \  
1 1 1 1 1 1 \  
1 1 1 1 1  
  
SWATH_DIM_X_SIZE=4980 4980 4980 4980 \  
2490 2490 2490 2490 2490 2490 \  
830 830 830 830 830  
  
SWATH_DIM_Y_SIZE=4200 4200 4200 4600 \  

```

```

2100 2100 2100 2100 2100 2100 \
700 700 700 700 700

SWATH_DATA_TYPES=21 21 21 21 21 21 21 21 21 21 21 23 23 23 23 23

SWATH_LAT_MIN=43.268890 43.268811 43.268492

SWATH_LAT_MAX=43.957176 43.957096 43.956780

SWATH_LON_MIN=-100.096085 -100.096012 -100.095719

SWATH_LON_MAX=-99.035063 -99.034991 -99.034701

SWATH_X_PIXEL_RES_METERS=15.006083 30.012167 90.036504

SWATH_Y_PIXEL_RES_METERS=15.005466 30.010931 90.032797

SWATH_X_PIXEL_RES_DEGREES=0.000186 0.000372 0.001115

SWATH_Y_PIXEL_RES_DEGREES=0.000135 0.000270 0.000810

```

7.2.4 Header File Data Ordering

It should be noted that order is important in the header files. For example, in the case of the header file with the three (3) swath objects all other objects correspond to the order of the swath names. The number of fields values are listed as '3 6 5' which means that the first swath in the list has 3 fields, the second swath in the list has 6 fields and the third swath has 5 fields. This holds true for all the parameters listed including data that is specific to each field. For example, the first 3 field names would be associated with the first swath, the next 6 field names with the second swath, and the final 5 fields with the third swath. The data types, dimensions, pixel sizes, etc. appear in the same order as their respective fields.

7.2.5 MISR Block Header File

The file HegMISRCoords.hdr is created by hegtool if the input file is a MISR file. The purpose of this file is to list the upper-left and lower-right coordinates of each block in the MISR-grid. This file is an ASCII file and the format is as follows:

NUM_BLOCKS = number of blocks in the grid

- The number of blocks in the MISR grid. This value is an integer.

MISR_DATA_FLAG = data flag

- A space separated list of integers. The number of integers corresponds to the number of blocks. A one (1) represents a block with valid data. A block not containing valid data would be represented by a zero (0).


```

MISR_UL_LAT= \
  66.222667511      67.448182064      68.629200205 \
  69.844139745      71.007048750      72.206807974 \
  73.398062353      74.578905134      75.684688709 \
  76.831101249      77.955651952      79.051667690 \
  80.109722514      81.015784744      81.939921316 \
  82.763750002      83.449366096      83.949640857 \
  84.216306788      84.216971119      83.951546234 \
  -58.902190108     -60.044391982     -61.231111722 \
  -62.353638361     -63.523647161     -64.684888677

```

```

MISR_UL_LON= \
  -176.915029963    -177.673288338    -178.928326962 \
  -179.880521059    178.591574567     177.364432075 \
  175.970749522     174.373584825     171.938453824 \
  169.735013024     167.129249378     164.008947141 \
  160.223704252     154.793275082     149.006517931 \
  141.832622041     133.010376510     122.455075848 \
  -18.317674258     -19.356120823     -20.485538797

```

```

MISR_LR_LAT= \
  65.752702723      66.889716660      67.939469463 \
  69.043628868      70.046571534      71.105956587 \
  72.139396375      73.142156782      74.003924580 \
  74.920418315      75.784536752      76.586187643 \
  77.313555064      77.813899148      78.344831170 \
  78.759543258      79.044844706      79.190494625 \
  -65.049024953     -66.279258963     -67.506288073

```

```

MISR_LR_LON= \
  170.339099246     168.979765543     167.114815102 \
  165.454042726     163.222283759     161.167701894 \
  158.878311830     156.318505721     153.018938526 \
  149.789526751     146.161639423     142.089034475 \
  137.530961090     132.110535270     126.577525356 \
  -8.255109393      -8.931367053      -9.673657430

```

7.2.7 Reading the Header Files

The headers are written to conform to Java Properties class standards. Therefore, reading the header files from Java is performed by creating a `FileInputStream` and loading (method `load()`) the stream into the `Properties`. The values can be accessed as a key and value pair per the Java API.

7.3 gdtif

The gdtif converter tool is used to read MISR data from an HDF file. MISR data sets have special HDF-EOS structures called MISR stacked grids. The program will obtain data of the region of interest by the user, using the SPATIAL_SUBSET_UL_CORNER and SPATIAL_SUBSET_LR_CORNER values, and reproject the data into a Geographic Projection (GEO), Albers Conical Equal Area (Albers), UTM Projection (UTM), Polar Stereographic Projection (PS), Transvers Mercator (TM), Lambert Azimuthal (LA), Lambert Conformal Conic (LCC), or State Plane (STP). Beginning with version 2.0, the Bilinear algorithm is implemented. Or the data can be left in its original Space Oblique Mercator (SOM) projection. It can convert the data into GeoTIFF format (GEO), HDF-EOS format (HDFEOS), Binary format (BIN), or Multi-Band GeoTIFF format. When creating HDF-EOS data sets, metadata files will also be created which preserve all the original Metadata from the original input file. OUTPUT_PIXEL_SIZE_X/Y can be used to control the resolution of the output data set.

7.3.1 gdtif Usage

The GDTIF program is run with the '-p' flag. For example, if the parameter file is named 'MyParameter.prm.' The command to run the resample program would be:

```
gdtif -p MyParameter.prm
```

7.3.2 Parameter Files

Parameter files are user-editable ASCII text files that contain information required by the HDF-EOS to GeoTIFF Converter (HEG). gdtif is a program for processing MISR SOM stacked-grid data. Information entered by the user in the HEG Graphical User Interface is stored in a parameter file, either for future use, or to run the gdtif program. In fact, the HEG GUI is basically a parameter file editing tool. This section specifies the parameter file format for the HEG gdtif program.

The HEG Tool requires information about the input and output data products in order to perform the desired data transformations. The parameter file contains this information in user-editable ASCII text format. For the most part, this information is stored as field-value pairs, corresponding to GUI fields and values.

The parameter file consists of field-value pairs and comments. Comments begin with the '#' character, and extend to the end of the line. Each field must begin on a new line, and may span more than one line for convenience and readability. Fields may occur in any order. All field-value tokens must be separated by white space (including the equals and parentheses symbols).

7.3.3 Parameter File Format

NUM_RUNS = number of runs in file

- The user may have a list of files to convert in the HEG GUI. The user may also want several different types of conversions performed on the same grid field. This field states how many conversions are requested in this parameter file. If the user is creating a Multi-

Band GeoTIFF, then all the runs (BEGIN/END pairs) are bands to be included in the single Multi-Band GeoTIFF output. All the runs will be of output file type: Multi-Band GeoTIFF. All objects processed for a Multi-Band GeoTIFF file must come from the same input file. A Multi-Band GeoTIFF output is indicated by appending the following string: “[MULTI_BAND_GEO TIFF:*N*”, where *N* is the total number of bands in the output GeoTIFF file. (Note the starting PIPE, “[” symbol). For example, a full line could look as such: “NUM_RUNS=3[MULTI_BAND_GEO TIFF:3” indicating 3 runs and a total of 3 bands in the Multi-Band GeoTIFF output file.

BEGIN and END

- Each conversion run listed in the parameter file must begin with the keyword BEGIN and end with the keyword END. The parameters may be listed in any order between the BEGIN and END keywords.

INPUT_FILENAME = input file name

- The input file name may optionally contain a directory path. This field is required, since much of the information required by the gdtif program does not come directly from the parameter file, but must be read from the input data file. An invalid file name will generate an error.

OBJECT_NAME = name of grid

- This field should contain the name of the grid exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple grids in the same file.

FIELD_NAME = name of field|

- This field should contain the name of the grid field exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple fields in the same grid. Note that “name of field” ends with a PIPE “[”. If it is left out the parameter file will not be read correctly.

BAND_NUMBER = band number

- This field should contain the number for the desired band. Since the field data can be 3-dimensional, it is essential to read a 2-dimensional slice from the data field. If the input field is 2-dimension, this number will default to 1. For the moment, this Field is not being used for MISR data Sets, but is required for proper functioning of the program.

SPATIAL_SUBSET_UL_CORNER = (int int) or (float float)

SPATIAL_SUBSET_LR_CORNER = (int int) or (float float)

- These are the coordinates of the upper-left and lower-right corners for spatial subsetting. Values indicate lat/lon values. These fields are normally required for MISR data otherwise, by default, the entire input image will be selected, which is not appropriate for a MISR data set which scans from North to South Pole.. Note that the spatial subsetting takes place in the input images space, not the output image space.

RESAMPLING_TYPE = type

- The resampling type may be NEAREST_NEIGHBOR, NN, BILINEAR, BI, CUBIC, CC, or CUBIC_CONVOLUTION. Presently, only BI processing is available and always resorts to this method.

OUTPUT_PROJECTION_TYPE = type

- The output projection type may be GEOGRAPHIC, GEO, ALBERS, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, TRANSVERSE_MERCATOR, TM, LAMBERT_AZIMUTHAL, LA, LAMBERT_CONFORMAL_CONIC, LCC or STATE_PLANE, STP..

ELLIPSOID_CODE

- This field is required for processing. At the moment, the program resorts to using the WGS84 Ellipsoid.

UTM_ZONE = utm number

- When the output projection type is UTM, a UTM zone value may optionally be specified. If present, the UTM zone overrides values specified in the output projection parameters field.

STP_ZONE = state plane zone number

- The zone number of the corresponding state plane zone (see Appendix B for state plane zone numbers). This field is only required when the output projection is state plane.

OUTPUT_PROJECTION_PARAMETERS = (p1 p2 ... p15)

- This array contains the 15 output projection parameter values. This field is optional; by default, all projection parameter values will be set to zero. (An exception is UTM: when the first two UTM projection parameters are zero, the projection will default to the scene center.) Projection parameter values are floating point; integer values will automatically be converted to floating point. If there are fewer than 15 projection parameter values specified, the remaining values will be set to zero. If there are more than 15 values specified, the extra values will be ignored.

OUTPUT_PIXEL_SIZE_X

- A single output pixel size, in the X (column) direction, may be specified in output projection units (meters). This field is optional; by default, the output pixel size will be the same as the input pixel size for the selected field determined by the HDF-EOS data set.

OUTPUT_PIXEL_SIZE_Y

- A single output pixel size, in the Y (column) direction, may be specified in output projection units (meters). This field is optional; by default, the output pixel size will be

the same as the input pixel size for the selected field determined by the HDF-EOS data set.

OUTPUT_PIXEL_SIZE = size

- A single output pixel size may be specified in output projection units (typically meters). This field is optional; by default, the output pixel size will be the same as the input pixel size for the selected field.

OUTPUT_FILENAME = output file name

- The output file name requires a full directory path. This field is required. An invalid file name will generate an error.

OUTPUT_TYPE = type

- This field specifies the type of output the user has requested. The type may be GEO for GeoTiff and Multi-Band GeoTIFF output, HDFEOS for Hdf-Eos grid output, or BIN for raw binary output. This field is required.

7.3.4 Sample of a Parameter File for gdtif

Below is a sample of a parameter file. Each field needs to have its own separate line.

```
NUM_RUNS = 1
```

```
BEGIN
```

```
INPUT_FILENAME=/home/hdfdata/MISR/MISR_TERRAIN_P187.hdf
```

```
OBJECT_NAME = BlueBand
```

```
FIELD_NAME = Blue Radiance/RDQI|
```

```
BAND_NUMBER = 1
```

```
SPATIAL_SUBSET_UL_CORNER = ( 40.0 11.0 )
```

```
SPATIAL_SUBSET_LR_CORNER = ( 36.0 23.0 )
```

```
RESAMPLING_TYPE = BI
```

```
OUTPUT_PROJECTION_TYPE = UTM
```

```
ELLIPSOID_CODE = WGS84
```

```
UTM_ZONE = 0
```

```
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 )
```

```
OUTPUT_PIXEL_SIZE_X = 275.0
```

```
OUTPUT_PIXEL_SIZE_Y = 275.0
```

```
OUTPUT_FILENAME = /home/outdata/MISR_BlueBand.tif
```

```
OUTPUT_TYPE = GEO
```

```
END
```

7.4 resample

resample performs conversions on HDF-EOS Grid objects for non-MISR data.

7.4.1 resample Usage

The resample program is run with the '-p' flag. For example, if the parameter file is named 'MyParameter.prm.' The command to run the resample program would be:

```
resample -p MyParameter.prm
```

Beginning with version 2.0 there are no other options associated with the resample program. The resample program produces a log file named resample.log which saves all the messages which appear during the resample run. This is a helpful way of tracking down any possible errors in the case where many conversions were described in one parameter file.

7.4.2 Parameter File Format

The parameter file consists of field-value pairs and comments. Comments begin with the '#' character, and extend to the end of the line. Each field must begin on a new line, and may span more than one line for convenience and readability. Fields may occur in any order. All field-value tokens must be separated by white space (including the equals and parentheses symbols)

NUM_RUNS = number of runs in file

- The user may have a list of files to convert in the HEG GUI. The user may also want several different types of conversions performed on the same grid field. This field states how many conversions are requested in this parameter file. If the user is creating a Multi-Band GeoTIFF, then all the runs (BEGIN/END pairs) are bands to be included in the single Multi-Band GeoTIFF output. All the runs will be of output file type: Multi-Band GeoTIFF. All objects processed for a Multi-Band GeoTIFF file must come from the same input file. A Multi-Band GeoTIFF output is indicated by appending the following string: "|MULTI_BAND_GEOTIFF:N", where N is the total number of bands in the output GeoTIFF file. (Note the starting PIPE, "|" symbol). For example, a full line could look as such: "NUM_RUNS=3|MULTI_BAND_GEOTIFF:3" indicating 3 runs and a total of 3 bands in the Multi-Band GeoTIFF output file.

BEGIN and END

- Each conversion run listed in the parameter file must begin with the keyword BEGIN and end with the keyword END. The parameters may be listed in any order between the BEGIN and END keywords.

INPUT_FILENAME = input file name

- The input file name may optionally contain a directory path. This field is required, since much of the information required by the resample program does not come directly from the parameter file, but must be read from the input data file. An invalid file name will generate an error.

OBJECT_NAME = name of grid

- This field should contain the name of the grid exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple grids in the same file.

FIELD_NAME = name of field

- This field should contain the name of the grid field exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple fields in the same grid.

SPATIAL_SUBSET_UL_CORNER = (int int) or (float float)

SPATIAL_SUBSET_LR_CORNER = (int int) or (float float)

- These are the coordinates of the upper-left and lower-right corners for spatial subsetting. Float values (containing a decimal point) indicate lat/lon values; integer values indicate row/column pairs. If *any* value is float, then lat/lon will be assumed. In the case of multi-resolution data sets, the highest resolution of any spectral band will be assumed for row/column values. These fields are optional; by default, the entire input image will be selected. Note that the spatial subsetting takes place in the input images space, not the output image space.

RESAMPLING_TYPE = type

- The resampling type may be NEAREST_NEIGHBOR, NN, BILINEAR, BI, CUBIC, CC, or CUBIC_CONVOLUTION. This field is optional; by default nearest neighbor resampling will be used.

OUTPUT_PROJECTION_TYPE = type

- The output projection type may be GEOGRAPHIC, GEO, ALBERS, INTEGERIZED_SINUSOIDAL, ISIN, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, or TM. This field is required.

OUTPUT_PROJECTION_PARAMETERS = (p1 p2 ... p15)

- This array contains the 15 output projection parameter values. This field is optional; by default, all projection parameter values will be set to zero. (An exception is UTM: when the first two UTM projection parameters are zero, the projection will default to the scene center.) Projection parameter values are floating point; integer values will automatically be converted to floating point. If there are fewer than 15 projection parameter values specified, the remaining values will be set to zero. If there are more than 15 values specified, the extra values will be ignored.

UTM_ZONE = zone

- When the output projection type is UTM, a UTM zone value may optionally be specified. If present, the UTM zone overrides values specified in the output projection parameters field.

STP_ZONE = state plane zone number

- The zone number of the corresponding state plane zone (see Appendix B for state plane zone numbers). This field is only required when the output projection is state plane.

OUTPUT_PIXEL_SIZE = size

- A single output pixel size may be specified in output projection units (typically meters). This field is optional; by default, the output pixel size will be the same as the input pixel size for the selected field.

OUTPUT_FILENAME = output file name

- The output file name may optionally contain a directory path. This field is required. An invalid file name will generate an error.

OUTPUT_TYPE = type

- This field specifies the type of output the user has requested. The type may be GEO for GeoTiff and Multi-Band GeoTIFF output, HDFEOS for HDF-EOS Grid output, or BIN for raw binary output. This field is required.

BAND_NUMBER = band number

- This field specifies the number of the 3rd dimension to convert. This field could be a colon (:) separated list of values when creating a geotiff image. This would allow the user to place multiple images in the same geotiff file. This field is optional.

BAND_NAME = band name

- This field specifies the name of the 3rd dimension. This field is only mandatory when the FOURTH_DIM field is used.

FOURTH_DIM = fourth dimension

- This field specifies the 4th dimension (when possible) to use. This field is optional.

FOURTH_DIM_NAME = name of fourth dimension

- This field specifies the name of the fourth dimension in the field dimension list. This field is only mandatory when the FOURTH_DIM field is used.

7.4.3 Sample of a Parameter File for resample

```
NUM_RUNS = 1
```

```
BEGIN
```

```
INPUT_FILENAME =
```

```
/home/hdf/data/MOD09GHK.A2000238.h20v11.001.2000253195532.hdf
```

```
OBJECT_NAME = MOD_Grid_L2g_2d
```

```

FIELD_NAME = sur_refl_b01_1
SPATIAL_SUBSET_UL_CORNER = ( -20.0 21.283409287 )
SPATIAL_SUBSET_LR_CORNER = ( -30.0 34.641291564 )
RESAMPLING_TYPE = NN
OUTPUT_PROJECTION_TYPE = GEO
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 )
OUTPUT_PIXEL_SIZE = 14.99993594144807
OUTPUT_FILENAME = /home/out/data/newbin.bin
OUTPUT_TYPE = BIN
END

```

7.5 swtif

The swtif converter tool is used to read a Swath object from an HDF-EOS file and convert it to a grid with all supported projections. Once converted the tool subsets the grid if the SPATIAL_SUBSET_UL_CORNER and SPATIAL_SUBSET_LR_CORNER values differ from the default values (values that HEG displays after opening input HDF file or the grid corner values determined by the tool for the whole swath) by one pixel. The output then is written to a GeoTIFF file. The swtif tool will also create HDF-EOS or Binary forms of the requested user file. Note that if BINARY output is requested, the tool creates *.hdr and *.dat files. The *.hdr file is an ASCII file that contains information about the output grid and *.dat is a binary file containing field data. Please also note that a *.met file is created automatically. This file is an ASCII file containing INVENTORY metadata that is written to the output HDF-EOS file. The attributes in the INVENTORY metadata are a minimum set of attributes required by ECS. If the required attributes exist in the input HDF-EOS file's coremetadata section, they will be set in the MCF file. The swtif tool will issue a warning for attributes not found in the input HDF file.

7.5.1 swtif Usage

The swtif program is run with the '-P' flag. For example, if the parameter file is named 'MyParameter.prm.' The command to run the swtif program would be:

```
swtif -P MyParameter.prm
```

7.5.2 Parameter File Format

The parameter file consists of field-value pairs and comments. Comments begin with the '#' character, and extend to the end of the line. Each field must begin on a new line, and may span more than one line for convenience and readability. Fields may occur in any order. All field-value tokens must be separated by white space (including the equals and parentheses symbols).

NUM_RUNS = number of runs in file

- The user may have a list of files to convert in the HEG GUI. The user may also want several different types of conversions performed on the same swath field. This field states how many conversions are requested in this parameter file. If the user is creating a

Multi-Band GeoTIFF, then all the runs (BEGIN/END pairs) are bands to be included in the single Multi-Band GeoTIFF output. All the runs will be of output file type: Multi-Band GeoTIFF. All objects processed for a Multi-Band GeoTIFF file must come from the same input file. A Multi-Band GeoTIFF output is indicated by appending the following string: “[MULTI_BAND_GEO TIFF:*N*”, where *N* is the total number of bands in the output GeoTIFF file. (Note the starting PIPE, “[” symbol). For example, a full line could look as such: “NUM_RUNS=3|MULTI_BAND_GEO TIFF:3” indicating 3 runs and a total of 3 bands in the Multi-Band GeoTIFF output file.

BEGIN and END

- Each conversion run listed in the parameter file must begin with the keyword BEGIN and end with the keyword END. The parameters may be listed in any order between the BEGIN and END keywords.

INPUT_FILENAME = input file name

- The input file name may optionally contain a directory path. This field is required, since much of the information required by the swtif program does not come directly from the parameter file, but must be read from the input data file. An invalid file name will generate an error.

OBJECT_NAME = name of swath

- This field should contain the name of the swath exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple swaths in the same file.

FIELD_NAME = name of field|

- This field should contain the name of the swath field exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple fields in the same swath. Note that “name of field” ends with a PIPE “[”. If it is left out the parameter file will not be read correctly.

OUTPUT_PIXEL_SIZE_X= size

- Output pixel size in x may be specified in output projection units (typically meters). By default, the output pixel size will be the same as the input pixel size for the selected field in the center of image.

OUTPUT_PIXEL_SIZE_Y= size

- Output pixel size in y may be specified in output projection units (typically meters). By default, the output pixel size will be the same as the input pixel size for the selected field in the center of image.

BAND_NUMBER = band number

- This field should contain the number for the desired band. Since the field data can be 3-dimensional, it is essential to read a 2-dimensional slice from the data field. If the input

field is 2-dimension, this number will default to 1. If the user has requested multiple images to appear in one geotiff file the band number will be a colon a colon (:) separated list of values.

RESAMPLING_TYPE = type

- The resampling type may be NEAREST_NEIGHBOR, NN, BILINEAR, BI, CUBIC, CC, or CUBIC_CONVOLUTION. This field is optional; by default nearest neighbor resampling will be used.

ELLIPSOID_CODE

- This field is required for processing. At the moment, the program resorts to using the WGS84 Ellipsoid

OUTPUT_PROJECTION_TYPE = type

- The output projection type may be GEOGRAPHIC, GEO, ALBERS, INTEGERIZED_SINUSOIDAL, ISIN, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, or TM. This field is required. For ASTER L1B on can also use NO_REPROJECTION, which will produce a satellite-path oriented UTM grid TIFF output.

OUTPUT_PROJECTION_PARAMETERS = (p1 p2 ... p15)

- This array contains the 15 output projection parameter values. This field is optional; by default, all projection parameter values will be set to zero. (An exception is UTM: when the first two UTM projection parameters are zero, the projection will default to the scene center.) Projection parameter values are floating point; integer values will automatically be converted to floating point. If there are fewer than 15 projection parameter values specified, the remaining values will be set to zero. If there are more than 15 values specified, the extra values will be ignored.

UTM_ZONE = zone

- When the output projection type is UTM, a UTM zone value may optionally be specified. If present, the UTM zone overrides values specified in the output projection parameters field.

STP_ZONE = state plane zone number

- The zone number of the corresponding state plane zone (see Appendix B for state plane zone numbers). This field is only required when the output projection is state plane.

SPATIAL_SUBSET_UL_CORNER = (float float)

SPATIAL_SUBSET_LR_CORNER = (float float)

- These are the coordinates of the upper-left and lower-right corners for spatial subsetting. Float values (containing a decimal point) indicate lat/lon values. If these values differ by

one pixel from the default values that are used for creating the original grid from the whole swath, the outputs will contain the subsetted grid..

OUTPUT_FILENAME = output file name

- The output file name may optionally contain a directory path. This field is required. An invalid file name will generate an error.

OUTPUT_TYPE = type

- This field specifies the type of output the user has requested. The type may be GEO for GeoTiff and Multi-Band GeoTIFF output, HDFEOS for HDF-EOS Grid output, or BIN for raw binary output. This field is required.

7.5.3 An Example of a Parameter File for swtif

```
NUM_RUNS = 1
```

```
BEGIN
INPUT_FILENAME = /hdfdata/AST_L1B/pg-PR1B0000-
2000080702_241_001.hdf
OBJECT_NAME = VNIR_Swath
FIELD_NAME = ImageData1|
BAND_NUMBER = 1
OUTPUT_PIXEL_SIZE_X = 15.0
OUTPUT_PIXEL_SIZE_Y = 15.0
SPATIAL_SUBSET_UL_CORNER = ( 43.957176 -100.096085 )
SPATIAL_SUBSET_LR_CORNER = ( 43.26889 -99.035063 )
RESAMPLING_TYPE = NN
OUTPUT_PROJECTION_TYPE = NO_REPROJECTION
ELLIPSOID_CODE = WGS84
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 )
OUTPUT_FILENAME = /outdata/AST_L1B/pg-PR1B0000-VNIR_Swath.tif
OUTPUT_TYPE = GEO
END
```

7.6 SWATH SUBSET/STITCH

The subset_stitch_swath converter tool is used to read 1 or more similar swaths from HDF files, convert them to grids with one of supported projection and stitch them together. During the conversion the tool also performs subsetting using the user provided subset upper left and lower right corner points (lat/lon) for the subset box. The output then is written to an HDF-EOS, TIFF, or Binary file depending on user's request. Note that if Binary output is requested the tool creates *.hdr and *.dat files. The *.hdr file is an ASCII file that contains information about the output grid and *.dat is a binary file containing field data. Please also note that a *.met file is created automatically. This file is an ASCII file containing INVENTORY metadata that is written to the output HDF-EOS file. The attributes in the INVENTORY metadata are a minimum set of

attributes required by ECS. If the required attributes exist in the input HDF-EOS file's coremetadata section, they will be set in the MCF file. The subset_stitch_swath tool will issue warning for attributes not found in the input HDF-EOS file.

7.6.1 Program subset_stitch_swath Usage

The `subset_stitch_swath` program is run with the '-p' flag. For example, if the parameter file is named 'MyParameter.prm.' The command to run the subset_stitch_swath program would be:

```
subset_stitch_swath -p MyParameter.prm
```

or if user do not want warnings when the granules to be stitched are too far apart:

```
subset_stitch_swath -p MyParameter.prm -A
```

7.6.2 Parameter File Format

The parameter file consists of field-value pairs and comments. Comments begin with the '#' character, and extend to the end of the line. Each field must begin on a new line, and may span more than one line for convenience and readability. Fields may occur in any order. All field-value tokens must be separated by white space (including the equals and parentheses symbols). Following is a sample of parameter file.

NUM_RUNS = number of runs in file

- The user may have a list of files to convert in the HEG GUI. The user may also want to stitch several different fields on the same swath. This field states how many stitchings are requested in this parameter file.

BEGIN and END

- Each conversion run listed in the parameter file must begin with the keyword BEGIN and end with the keyword END. The parameters may be listed in any order between the BEGIN and END keywords.

NUMBER_INPUTFILES = number of files containing the swath fields to be stitched

- This field is the number of files that contain the desired swath fields that to be stitched. This number should agree with the number of files entered in the INPUT_FILENAMES field. Note that if this number is one, and there is only one file name in the INPUT_FILENAMES, only one field in the input file will be used for conversion.

INPUT_FILENAMES = input file names

- The input file names may optionally contain a directory path. This field is required, since much of the information required by the subset_stitch_swath program does not come directly from the parameter files, but must be read from the input data file. An invalid file name will generate an error. If more than one input file is entered they must be separated by a PIPE "|".

OUTPUT_FILENAME = output file name

- The output file name. This field is required. An invalid file name will generate an error. If user requests Binary instead of HDF-EOS file, the tool will generate *.hdr and *.dat file names using this output file name.

OBJECT_NAME = name of swath

- This field should contain the name of the swath exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple swaths in the same file.

FIELD_NAME = name of field|

- This field should contain the name of the swath field exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple fields in the same swath. Note that “name of field” ends with a PIPE “|”. If it is left out the parameter file will not be read correctly.

OUTPUT_OBJECT_NAME = name of grid in the output file

- This field should contain the name of the grid that will be created in the output HDF-EOS file. The same name as in the OBJECT_NAME can be used for this field. This field is required since HDF-EOS will require a grid name in the output file.

BAND_NUMBER = band number

- This field should contain the number for the desired band. Since the field data can be 3-dimensional, it is essential to read a 2-dimensional slice from the data field. If the input field is 2-dimensional, this number will default to 1. Note that the desired fields in all input files must have the requested band number.

SPATIAL_SUBSET_UL_CORNER = (float float)

SPATIAL_SUBSET_LR_CORNER = (float float)

- These are the coordinates of the upper-left and lower-right corners for spatial subsetting. Float values (containing a decimal point) indicate lat/lon values. These fields are required since the output grid will be created using these corner latitudes and longitudes.

OUTGRID_X_PIXELSIZE = pixel size along the X (longitude) axis of output grid

OUTGRID_Y_PIXELSIZE = pixel size along the Y (latitude) axis of output grid

- These fields are in Decimal Degrees and are required since the tool uses them to find the number of pixels in the output grid.

RESAMPLING_TYPE = type

- The resampling type may be NEAREST_NEIGHBOR, NN, BILINEAR, BI, CUBIC, CC, or CUBIC_CONVOLUTION. Presently, only BI processing is available and always resorts to this method.

OUTPUT_PROJECTION_TYPE = type

- The output projection type may be GEOGRAPHIC, GEO, ALBERS, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, TRANSVERSE_MERCATOR, TM, LAMBERT_AZIMUTHAL, LA, LAMBERT_CONFORMAL_CONIC, LCC or STATE_PLANE, STP..

ELLIPSOID_CODE

- This field is required for processing. At the moment, the program resorts to using the WGS84 Ellipsoid.

UTM_ZONE = utm number

- When the output projection type is UTM, a UTM zone value may optionally be specified. If present, the UTM zone overrides values specified in the output projection parameters field.

STP_ZONE = state plane zone number

- The zone number of the corresponding state plane zone (see Appendix B for state plane zone numbers). This field is only required when the output projection is state plane.

OUTPUT_PROJECTION_PARAMETERS = (p1 p2 ... p15)

- This array contains the 15 output projection parameter values. This field is optional; by default, all projection parameter values will be set to zero. (An exception is UTM: when the first two UTM projection parameters are zero, the projection will default to the scene center.) Projection parameter values are floating point; integer values will automatically be converted to floating point. If there are fewer than 15 projection parameter values specified, the remaining values will be set to zero. If there are more than 15 values specified, the extra values will be ignored.

OUTPUT_STITCHED_FILENAME = name of output stitched file

- This field is not used by the tool and will be removed in the future. User may use a dummy name for this field.

SAVE_STITCHED_FILE = YES or NO

- This field should be YES or NO. Please use NO for this field. It will be removed from the parameter file in the future.

OUTPUT_TYPE = type

- This field specifies the type of output the user has requested. The type may be HDFEOS for Hdf-Eos grid output, or BIN for raw binary output. This field is required.

7.6.3 An Example of a Parameter File for subset_stitch_swath

```
NUM_RUNS = 1

BEGIN
NUMBER_INPUTFILES = 2
INPUT_FILENAMES = /hdfdata/AST_L1B/pg-PR1B0000-
2001031402_049_001.hdf|/hdfdata/AST_L1B/pg-PR1B0000-
2001031402_050_001.hdf
OBJECT_NAME = VNIR_Swath|
FIELD_NAME = ImageData1|
BAND_NUMBER = 1
SPATIAL_SUBSET_UL_CORNER = ( 49.157685 -124.25158 )
SPATIAL_SUBSET_LR_CORNER = ( 47.930699 -122.852332 )
OUTPUT_OBJECT_NAME = VNIR_Swath|
OUTGRID_X_PIXELSIZE = 15.0
OUTGRID_Y_PIXELSIZE = 15.0
RESAMPLING_TYPE = NN
OUTPUT_PROJECTION_TYPE = UTM
ELLIPSOID_CODE = WGS84
UTM_ZONE = 0
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 )
OUTPUT_FILENAME = /outdata/VNIR_Swath.tif
SAVE_STITCHED_FILE = NO
OUTPUT_STITCHED_FILENAME = /outdata/VNIR_Swath_stitched_.hdf
OUTPUT_TYPE = GEO
END
```

7.7 Grid Subset/Stitch

The subset_stitch_grid converter tool is used to read 1 or more similar grids from HDF-EOS files, stitch them together and then subset the stitched grid (if requested). The output then is written to an HDF-EOS or Binary file depending on user's request. Note that if Binary output is requested the tool creates *.hdr and *.dat files. The *.hdr file is an ASCII file that contains information about the output grid and *.dat is a binary file containing field data. Please also note that a *.met file is created automatically. This file is an ASCII file containing INVENTORY metadata that is written to the output HDF-EOS file. The attributes in the INVENTORY metadata are a minimum set of attributes required by ECS. If the required attributes exist in the input HDF file's coremetadata section, they will be set in the MCF file. The subset_stitch_grid tool will issue warning for attributes not found in the input HDF file.

7.7.1 Program `subset_stitch_grid` Usage

The `subset_stitch_grid` program is run with the '-P' flag. For example, if the parameter file is named 'MyParameter.prm.' The command to run the `subset_stitch_grid` program would be:

```
subset_stitch_grid -P MyParameter.prm
```

7.7.2 Parameter File Format

The parameter file consists of field-value pairs and comments. Comments begin with the '#' character, and extend to the end of the line. Each field must begin on a new line, and may span more than one line for convenience and readability. Fields may occur in any order. All field-value tokens must be separated by white space (including the equals and parentheses symbols). Following is a sample of parameter file.

`NUM_RUNS` = number of runs in file

- The user may have a list of files to convert in the HEG GUI. The user may also want to stitch several different fields on the same grid. This field states how many stitchings are requested in this parameter file.

`BEGIN` and `END`

- Each conversion run listed in the parameter file must begin with the keyword `BEGIN` and end with the keyword `END`. The parameters may be listed in any order between the `BEGIN` and `END` keywords.

`NUMBER_INPUTFILES` = number of files containing the grid fields to be stitched

- This field is the number of files that contain the desired grid fields that to be stitched. This number should agree with the number of files entered in the `INPUT_FILENAMES` field. Note that if this number is one, and there is only one file name in the `INPUT_FILENAMES`, only one field in the input file will be used for conversion.

`INPUT_FILENAMES` = input file names

- The input file names may optionally contain a directory path. This field is required, since much of the information required by the `subset_stitch_grid` program does not come directly from the parameter files, but must be read from the input data file. An invalid file name will generate an error. If more than one input file is entered they must be separated by a PIPE "|".

`OUTPUT_FILENAME` = output file name

- The output subsetting file name. This field is required. An invalid file name will generate an error. If user requests Binary instead of HDF-EOS file, the tool will generate *.hdr and *.dat file names for the subsetting stitched grid using this output file name.

OBJECT_NAME = name of grid

- This field should contain the name of the grid exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple grids in the same file.

FIELD_NAME = name of field

- This field should contain the name of the grid field exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple fields in the same grid. Note that “name of field” ends with a PIPE “|”. If it is left out the parameter file will not be read correctly.

OUTPUT_OBJECT_NAME = name of grid in the output file

- This field should contain the name of the grid that will be created in the output HDF-EOS file. The same name as in the OBJECT_NAME can be used for this field. This field is required since HDF-EOS will require a grid name in the output file.

BAND_NUMBER = band number

- This field should contain the number for the desired band. Since the field data can be 3-dimensional, it is essential to read a 2-dimensional slice from the data field. If the input field is 2-dimension, this number will default to 1. Note that the desired fields in all input files must have the requested band number.

SPATIAL_SUBSET_UL_CORNER = (float float)

SPATIAL_SUBSET_LR_CORNER = (float float)

- These are the coordinates of the upper-left and lower-right corners for spatial subsetting. Float values (containing a decimal point) indicate lat/lon values. These fields are required since the output grid will be created using these corner latitudes and longitudes.

OUTGRID_X_PIXELSIZE = pixel size along the X (longitude) axis of output grid

OUTGRID_Y_PIXELSIZE = pixel size along the Y (latitude) axis of output grid

- These fields are in Decimal Degrees and are required. If 0.00 entered for the value, the tool will use the pixel size from the first input file.

OUTPUT_STITCHED_FILENAME = name of output stitched file

- This field is the name of the stitched output file that is created by stitching all grids. If OUTPUT_TYPE is HDF-EOS and SAVE_STICHED_FILE is YES the HDF-EOS file will be saved. If OUTPUT_TYPE is BIN and SAVE_STICHED_FILE is YES the file name will be used to create *.hdr and *.dat for the stitched file.

RESAMPLING_TYPE = type

- The resampling type may be NEAREST_NEIGHBOR, NN, BILINEAR, BI, CUBIC, CC, or CUBIC_CONVOLUTION. Presently, only BI processing is available and always resorts to this method.

OUTPUT_PROJECTION_TYPE = type

- The output projection type may be GEOGRAPHIC, GEO, ALBERS, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, TRANSVERSE_MERCATOR, TM, LAMBERT_AZIMUTHAL, LA, LAMBERT_CONFORMAL_CONIC, LCC or STATE_PLANE, STP..

ELLIPSOID_CODE

- This field is required for processing. At the moment, the program resorts to using the WGS84 Ellipsoid.

UTM_ZONE = utm number

- When the output projection type is UTM, a UTM zone value may optionally be specified. If present, the UTM zone overrides values specified in the output projection parameters field.

STP_ZONE = state plane zone number

- The zone number of the corresponding state plane zone (see Appendix B for state plane zone numbers). This field is only required when the output projection is state plane.

OUTPUT_PROJECTION_PARAMETERS = (p1 p2 ... p15)

- This array contains the 15 output projection parameter values. This field is optional; by default, all projection parameter values will be set to zero. (An exception is UTM: when the first two UTM projection parameters are zero, the projection will default to the scene center.) Projection parameter values are floating point; integer values will automatically be converted to floating point. If there are fewer than 15 projection parameter values specified, the remaining values will be set to zero. If there are more than 15 values specified, the extra values will be ignored.

SAVE_STITCHED_FILE = YES or NO

- This field should be YES or NO. If it is YES output stitched file will be saved in HDF-EOS format or Binary depending on the OUTPUT_TYPE value.

OUTPUT_TYPE = type

- This field specifies the type of outputs the user has requested. The type may be HDFEOS for Hdf-Eos grid output, or BIN for raw binary output. This field is required.

7.7.3 An Example of a Parameter File for subset_stitch_grid

```
NUM_RUNS = 1

BEGIN
NUMBER_INPUTFILES = 2
INPUT_FILENAMES = /hdfdata/MODIS/MOD09A1.A2001065.h28v04.003.
2001190021128.hdf|/hdfdata/MODIS/MOD09A1.A2001065.h28v05.003.2001
190024429.hdf
OBJECT_NAME = MOD_Grid_500m_Surface_Reflectance|
FIELD_NAME = sur_refl_b01|
BAND_NUMBER = 1
SPATIAL_SUBSET_UL_CORNER = ( 50.0 115.470971881 )
SPATIAL_SUBSET_LR_CORNER = ( 30.0 171.135399879 )
OUTPUT_OBJECT_NAME = MOD_Grid_500m_Surface_Reflectance|
OUTGRID_X_PIXELSIZE = 463.312717
OUTGRID_Y_PIXELSIZE = 463.312717
OUTPUT_FILENAME = /outdata/MOD_Grid_500m_Surface_Reflectance.tif
SAVE_STITCHED_FILE = NO
OUTPUT_STITCHED_FILENAME = /outdata/MOD_Grid_500m_Surface_
Reflectance_stitched_.hdf
OUTPUT_TYPE = GEO
RESAMPLING_TYPE = BI
OUTPUT_PROJECTION_TYPE = UTM
ELLIPSOID_CODE = WGS84
UTM_ZONE = 0
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 )
END
```

7.8 Subsample_grid

The `subsample_grid` tool is used to perform subsampling on Grid data sets (i.e. MISR or MODIS).

7.8.1 Program `subsample_grid` Usage

The `subsample_grid` program is run with the '-p' flag. For example, if the parameter file is named 'MyParameter.prm.' The command to run the `subset_stitch_grid` program would be:

```
subsample_grid -p MyParameter.prm
```

7.8.2 Parameter File Format

The parameter file consists of field-value pairs and comments. Comments begin with the '#' character, and extend to the end of the line. Each field must begin on a new line, and may span

more than one line for convenience and readability. Fields may occur in any order. All field-value tokens must be separated by white space (including the equals and parentheses symbols). Following is a sample of parameter file.

NUM_RUNS = number of runs in file

- The user may have a list of files to convert in the HEG GUI. The user may also want to subsample several different fields on the same grid. This field states how many subsamplings are requested in this parameter file.

BEGIN and END

- Each conversion run listed in the parameter file must begin with the keyword BEGIN and end with the keyword END. The parameters may be listed in any order between the BEGIN and END keywords.

INPUT_FILENAME = input file name

- The input file name may optionally contain a directory path. This field is required, since much of the information required by the swtif program does not come directly from the parameter file, but must be read from the input data file. An invalid file name will generate an error.

OUTPUT_FILENAME = output HDF file name

- The output subsetted HDF file name. This field is required. An invalid file name will generate an error. If user requests BINARY instead of HDFEOS file, the tool will generate *.hdr and *.dat file names for the subsetted stitched grid using this output file name.

OBJECT_NAME = name of grid

- This field should contain the name of the grid exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple grids in the same file.

FIELD_NAME = name of field|

- This field should contain the name of the grid field exactly as it appears in the HDF-EOS file. This field is required since HDF-EOS files allow multiple fields in the same grid. Note that “name of field” ends with a PIPE “|”. If it is left out the parameter file will not be read correctly.

OBJECT_TYPE=object type

- This field identifies the type of input data set from which the input field originates. If the input data set is a MISR data set, then object type is MISRGRID. If it’s a MODIS data set, then the object type is GRID.

BAND_NUMBER = band number

- This field should contain the number for the desired band. Since the field data can be 3-dimensional, it is essential to read a 2-dimensional slice from the data field. If the input field is 2-dimensional, this number will default to 1. Note that the desired fields in all input files must have the requested band number.

SPATIAL_SUBSET_UL_CORNER = (float float)

SPATIAL_SUBSET_LR_CORNER = (float float)

- These are the coordinates of the upper-left and lower-right corners for spatial subsetting. Float values (containing a decimal point) indicate lat/lon values. These fields are required since the output grid will be created using these corner latitudes and longitudes.

RESAMPLING_TYPE = type

- The resampling type may be NEAREST_NEIGHBOR, NN, BILINEAR, BI, CUBIC_CONVOLUTION, CUBIC, or CC. Presently, only BI processing is available and always resorts to this method.

OUTPUT_PROJECTION_TYPE = type

- The output projection type may be GEOGRAPHIC, GEO, ALBERS, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, TRANSVERSE_MERCATOR, TM, LAMBERT_AZIMUTHAL, LA, LAMBERT_CONFORMAL_CONIC, LCC, or STATE_PLANE, STP. Presently, only MISR can be reprojected. Output from MODIS data sets will retain data in their original projections.

ELLIPSOID_CODE = code

- This field is required for processing. At the moment, the program resorts to using the WGS84 Ellipsoid.

UTM_ZONE = utm number

- When the output projection type is UTM, a UTM zone value may optionally be specified. If present, the UTM zone overrides values specified in the output projection parameters field.

OUTPUT_PROJECTION_PARAMETERS = (p1 p2 ... p15)

- This array contains the 15 output projection parameter values. This field is optional; by default, all projection parameter values will be set to zero. (An exception is UTM: when the first two UTM projection parameters are zero, the projection will default to the scene center.) Projection parameter values are floating point; integer values will automatically be converted to floating point. If there are fewer than 15 projection parameter values specified, the remaining values will be set to zero. If there are more than 15 values specified, the extra values will be ignored.

OUTPUT_PIXEL_SIZE_X

- A single output pixel size, in the X (column) direction, may be specified in output projection units (meters). This field is optional; by default, the output pixel size will be the same as the input pixel size for the selected field determined by the HDF-EOS data set.

OUTPUT_PIXEL_SIZE_Y

- A single output pixel size, in the Y (column) direction, may be specified in output projection units (meters). This field is optional; by default, the output pixel size will be the same as the input pixel size for the selected field determined by the HDF-EOS data set.

OUTPUT_PIXEL_SIZE = size

- A single output pixel size may be specified in output projection units (typically meters). This field is optional; by default, the output pixel size will be the same as the input pixel size for the selected field.

OUTPUT_TYPE = type

- This field specifies the type of outputs the user has requested. The type may be HDFEOS for Hdf-Eos grid output. This is the only type allowed for subsampling. This field is required.

N_SUBSAMPLES=number of subsample (int)

- This field indicates the number of subsamples output in the HDFEOS data set. Basically, they can be stacked inside the HDFEOS data set.

X_START = x_start (int)

Y_START=y_start (int)

- These fields indicate the starting X and Y positions in the field that subsampling is performed. A “:” is used to separate values for multiple subsamples.

X_STRIDE=x_stride (int)

Y_STRIDE=y_stride (int)

- These fields indicate the strides that data will be subsampled in the X and Y directions. A “:” is used to separate values for multiple subsamples.

7.8.3 Example Parameter Files for subsample_grid

The following is an example of a parameter file for subsampling a MODIS (MOD09GHK) data set:

```
NUM_RUNS = 1
```

```

BEGIN
INPUT_FILENAME =
/net/htsc/htsc/pgs/enielsen/MOD09GHK.A2000238.h20v11.001.2000253195532.hdf
OBJECT_NAME = MOD_Grid_L2g_2d
OBJECT_TYPE = GRID
FIELD_NAME = sur_refl_b02_1|
BAND_NUMBER = 1
SPATIAL_SUBSET_UL_CORNER = ( -20.0 21.283409287 )
SPATIAL_SUBSET_LR_CORNER = ( -30.0 34.641291564 )
RESAMPLING_TYPE = BI
OUTPUT_PROJECTION_TYPE = GEO
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 )
OUTPUT_FILENAME =
/net/htsc/htsc/pgs/cpradera/MODIS_test/MOD09GHK_subsample_test_aaa.hdf
OUTPUT_TYPE = HDFEOS
N_SUBSAMPLES = 4
X_START = 0:0:0:0
Y_START = 0:0:0:0
X_STRIDE = 2:3:4:5
Y_STRIDE = 3:6:5:10
END

```

The following is an example of a parameter file for subsampling a MISR (ELLIPSOID) data set:

```

NUM_RUNS = 1

BEGIN
INPUT_FILENAME =
/net/htsc/htsc/pgs/cpradera/data/MISR/MISR_AM1_GRP_ELLIPSOID_GM_P041_O001040_A
F_02.hdf
OBJECT_NAME = BlueBand
OBJECT_TYPE = MISRGRID
FIELD_NAME = Blue Radiance/RDQI|
BAND_NUMBER = 1
SPATIAL_SUBSET_UL_CORNER = ( 17.0 -126.0 )
SPATIAL_SUBSET_LR_CORNER = ( 16.0 -119.0 )
RESAMPLING_TYPE = BI
OUTPUT_PROJECTION_TYPE = UTM
ELLIPSOID_CODE = WGS84
UTM_ZONE = 0
OUTPUT_PROJECTION_PARAMETERS = ( 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 )

```

```
OUTPUT_PIXEL_SIZE_X = 1100.0
OUTPUT_PIXEL_SIZE_Y = 1100.0
OUTPUT_FILENAME =
/net/htsc/htsc/pgs/cpradera/MISR_test/MISR_ELLIPSOID_abe_subsample_aaa.hdf
OUTPUT_TYPE = HDFEOS
N_SUBSAMPLES = 2
X_START = 3:8
Y_START = 8:3
X_STRIDE = 1:1
Y_STRIDE = 1:1
END
```

8. Output Data Formats

The HEG tool can be used to produce three output file types: GeoTIFF, HDF-EOS Grid and binary. GeoTIFF output is input to ARCVIEW, ERDAS and ENVI applications. HDF-EOS is assessable to ENVI and through the standard HDF-EOS library interface. In this section, we will describe only the binary output, which will require custom software to access.

8.1 Raw Binary File Description

The HDF-EOS to GeoTIFF Conversion Tool (HEG) allows the option of creating a binary data file. Since the binary file is not self-describing an associated ASCII data file is created which describes the raw binary file (Section 8.2)

8.1.1 Binary File Description

The binary file is written in the most basic form possible. The input table (or field) is read in one row at a time. That row of data is then written out to the binary file, using fwrite(), before the next row is read in to memory. Below is a pseudo-code illustration of the algorithm used to write the raw binary file.

```
dataSize = size, in bytes, of datatype in table
dataBuf = calloc(dataSize, numberColumns);
```

```
For (loop = 0; loop < numberRows; loop++)
{
    dataBuf = readARowOfData();
    writeDataUsingfwrite(dataBuf);
}
```

8.1.2 Header File

To correctly read the binary file the user must interpret the ASCII header file. An example of a header file is provided below:

```
PROJECTION_TYPE = GEOGRAPHIC

PROJECTION_PARAMETERS = (
    0.000000000 0.000000000 0.000000000
    0.000000000 0.000000000 0.000000000
    0.000000000 0.000000000 0.000000000
    0.000000000 0.000000000 0.000000000
    0.000000000 0.000000000 0.000000000 )

# COORDINATE_ORIGIN = UL
```

```
UL_CORNER_LATLON = ( -20.000031960 21.283705445 )
UR_CORNER_LATLON = ( -20.000031960 21.533970810 )
LL_CORNER_LATLON = ( -20.208365627 21.283705445 )
LR_CORNER_LATLON = ( -20.208365627 21.533970810 )
```

```
# UL_CORNER_XY = ( 21.283705445 -20.000031960 )
# UR_CORNER_XY = ( 21.533970810 -20.000031960 )
# LL_CORNER_XY = ( 21.283705445 -20.208365627 )
# LR_CORNER_XY = ( 21.533970810 -20.208365627 )
```

```
# UL_GRING_LATLON = ( -20.000031960 21.283705445 )
# UR_GRING_LATLON = ( -20.000031960 21.505410710 )
# LL_GRING_LATLON = ( -20.208365627 21.312055369 )
# LR_GRING_LATLON = ( -20.208365627 21.534055946 )
```

```
NBANDS = 1
BANDNAMES = ( sur_refl_b01_1 )
DATA_TYPE = ( INT16 )
NLINES = ( 51 )
NSAMPLES = ( 61 )
PIXEL_SIZE = ( 15.00 )
MIN_VALUE = ( -100 )
MAX_VALUE = ( 16000 )
BACKGROUND_FILL = ( -28672 )
# SCALE_FACTOR = ( 10000.000000 )
# OFFSET = ( 0.000000 )
```

All lines that begin with the pound sign (#) are comment lines. The remaining lines are described below.

PROJECTION_TYPE = projection type

- This parameter contains the projection of the binary file.

PROJECTION_PARAMETERS = (p01 p02 ... p15)

- This parameter contains the projection parameters of the binary file.

UL_CORNER_LATLON = (latitude value longitude value)

- This parameter contains the latitude and longitude of the upper left corner of the binary data file.

UR_CORNER_LATLON = (latitude value longitude value)

- This parameter contains the latitude and longitude of the upper right corner of the binary data file.

LL_CORNER_LATLON = (latitude value longitude value)

- This parameter contains the latitude and longitude of the lower left corner of the binary data file.

LR_CORNER_LATLON = (latitude value longitude value)

- This parameter contains the latitude and longitude of the lower right corner of the binary data file.

NBANDS = number of bands

- This parameter contains the number of bands written to the output data file. Each band is written to a separate binary data file, and the band name of each band is used in the output name of the data file.

BANDNAMES = (band name1, band name2, ... band nameN)

- This parameter contains the field name(s) that were written to the binary files. There should be nbands values in the list.

DATA_TYPE = (hdf data type1, hdf data type2, ... hdf data typen)

- This parameter contains the HDF data types that were written in each of the binary files. There should be nbands values in the list.

NLINES = (number of lines1, number of lines2, ... number of linesN)

- This parameter contains the number of rows written in each of the binary files. There should be nbands values in the list.

NSAMPLES = (number of samples1, number of samples2, ... number of samplesn)

- This parameter contains the number of columns written in each of the binary files. There should be nbands values in the list.

PIXEL_SIZE = (pixel size1, pixel size2, ... pixel sizen)

- This parameter contains the pixel sizes written in each of the binary files. There should be nbands values in the list.

MIN_VALUE = (minimum value1, minimum value2, ... minimum valuen)

- This parameter contains the minimum data values written in each of the binary files. There should be nbands values in the list.

MAX_VALUE = (maximum value1, maximum value2, ... maximum valuen)

- This parameter contains the maximum data values written in each of the binary files. There should be nbands values in the list.

BACKGROUND_FILL = (fill value1, fill value2, ... fill valuen)

- This value contains the data fill values written in each of the binary files. There should be nbands values in the list.

8.1.3 Reading the Binary File

Once the user has a grasp on the header file reading the binary file is quite simple. An example of reading the binary file described in the above header file is provided here:

```
#include <stdio.h>
#include "hdf.h"

#define ROWS 51 /* NLINES */
#define COLS 61 /* NSAMPLES */

int main ()
{
    char *fileName = "/home/binary/data/bintest.sur_refl_b01_1.dat";
    FILE *fp;
    int rows;
    int cols;
    int dataSize;
    int16 *dataBuf;
    size_t amountRead;

    fp = fopen(fileName,"rb");
    if (fp == (FILE *) NULL)
    {
        printf("Error: unable to open input file - %s\n",fileName);
        exit(1);
    }

    dataSize = DFKNTsize(DFNT_INT16);
    dataBuf = (int16 *) calloc(COLS,dataSize);
    if (dataBuf == (int16 *) NULL)
    {
        printf("Error: unable to allocate memory for dataBuf - bytes needed - %d\n",
              (int) (COLS * dataSize));
        fclose(fp);
        exit(1);
    }
}
```

```

for (rows = 0; rows < ROWS; rows++)
{
    amountRead = fread((void *) dataBuf,(size_t) dataSize, (size_t) COLS, fp);
    if (amountRead == COLS)
    {
        int16 *temBuf = dataBuf;

        for (cols = 0; cols < COLS; cols++)
        {
            printf("%d ", (int) (temBuf+cols));
        }
        printf("\n");
    }
    else
    {
        printf("Error: data read problem - (amount read, should be) - (%d, %d)\n",
              (int) amountRead, (int) COLS);

        free(dataBuf);
        fclose(fp);
        exit(1);
    }
}

free(dataBuf);
fclose(fp);
return 0;
}

```

8.2 ASCII Metadata

The following is an example of a filled in template for an ASCII metadata file. This file is created by the HEG tool and is attached to output HDF-EOS files as an HDF global attribute.

```

GROUP = INVENTORYMETADATA
GROUPTYPE = MASTERGROUP
  GROUP = CollectionDescriptionClass
    OBJECT = ShortName
      Data_Location = "PGE"
      TYPE = "STRING"
      NUM_VAL = 1
      Mandatory = "TRUE"
    END_OBJECT = ShortName
  OBJECT = VersionID
    Data_Location = "PGE"
    Value = 1

```

```

    TYPE = "INTEGER"
    NUM_VAL = 1
    Mandatory = "TRUE"
  END_OBJECT = VersionID
END_GROUP = CollectionDescriptionClass
GROUP = ECSDDataGranule
  OBJECT = SizeMBECSDDataGranule
    Data_Location = "DSS"
    TYPE = "DOUBLE"
    NUM_VAL = 1
    Mandatory = "FALSE"
  END_OBJECT = SizeMBECSDDataGranule
  OBJECT = LocalGranuleID
    Data_Location = "PGE"
    Value = "AST_06V#002042820011613570000000.hdf"
    TYPE = "STRING"
    NUM_VAL = 1
    Mandatory = "FALSE"
  END_OBJECT = LocalGranuleID
  OBJECT = ProductionDateTime
    Data_Location = "TK"
    TYPE = "TIME"
    NUM_VAL = 1
    Mandatory = "TRUE"
  END_OBJECT = ProductionDateTime
END_GROUP = ECSDDataGranule
GROUP = PGEVersionClass
  OBJECT = PGEVersion
    Data_Location = "PGE"
    Value = "2.5.5"
    TYPE = "STRING"
    NUM_VAL = 1
    Mandatory = "FALSE"
  END_OBJECT = PGEVersion
END_GROUP = PGEVersionClass
GROUP = SingleDateTime
  OBJECT = TimeofDay
    Data_Location = "PGE"
    Value = "16:13:57.869000"
    TYPE = "STRING"
    NUM_VAL = 1
    Mandatory = "TRUE"
  END_OBJECT = TimeofDay
  OBJECT = CalendarDate
    Data_Location = "PGE"

```

```

Value = "2001-04-28"
TYPE = "DATE"
NUM_VAL = 1
Mandatory = "TRUE"
END_OBJECT = CalendarDate
END_GROUP = SingleDateTime
GROUP = RangeDateTime
OBJECT = RangeEndingTime
Data_Location = "PGE"
Value = "18:40:00.000000"
TYPE = "STRING"
NUM_VAL = 1
Mandatory = "TRUE"
END_OBJECT = RangeEndingTime
OBJECT = RangeEndingDate
Data_Location = "PGE"
Value = "2001-03-03"
TYPE = "DATE"
NUM_VAL = 1
Mandatory = "TRUE"
END_OBJECT = RangeEndingDate
OBJECT = RangeBeginningTime
Data_Location = "PGE"
Value = "18:35:00.000000"
TYPE = "STRING"
NUM_VAL = 1
Mandatory = "TRUE"
END_OBJECT = RangeBeginningTime
OBJECT = RangeBeginningDate
Data_Location = "PGE"
Value = "2001-03-03"
TYPE = "DATE"
NUM_VAL = 1
Mandatory = "TRUE"
END_OBJECT = RangeBeginningDate
END_GROUP = RangeDateTime
GROUP = SpatialDomainContainer
GROUP = HorizontalSpatialDomainContainer
GROUP = BoundingRectangle
OBJECT = WestBoundingCoordinate
Data_Location = "PGE"
NUM_VAL = 1
TYPE = "DOUBLE"
Mandatory = "TRUE"
VALIDRULE = "Range(-180.0,+180.0)"

```

```

END_OBJECT = WestBoundingCoordinate
OBJECT = NorthBoundingCoordinate
  Data_Location = "PGE"
  NUM_VAL = 1
  TYPE = "DOUBLE"
  Mandatory = "TRUE"
  VALIDRULE = "Range(-90.0,+90.0)"
END_OBJECT = NorthBoundingCoordinate
OBJECT = EastBoundingCoordinate
  Data_Location = "PGE"
  NUM_VAL = 1
  TYPE = "DOUBLE"
  Mandatory = "TRUE"
  VALIDRULE = "Range(-180.0,+180.0)"
END_OBJECT = EastBoundingCoordinate
OBJECT = SouthBoundingCoordinate
  Data_Location = "PGE"
  NUM_VAL = 1
  TYPE = "DOUBLE"
  Mandatory = "TRUE"
  VALIDRULE = "Range(-90.0,+90.0)"
END_OBJECT = SouthBoundingCoordinate
END_GROUP = BoundingRectangle
END_GROUP = HorizontalSpatialDomainContainer
END_GROUP = SpatialDomainContainer
GROUP = InputGranule
  OBJECT = InputPointer
  Data_Location = "PGE"
  Value = ("LGID:AST_L1A:002:ASTL1A 0103021936190103130134")
  TYPE = "STRING"
  NUM_VAL = 1
  Mandatory = "TRUE"
  END_OBJECT = InputPointer
END_GROUP = InputGranule

GROUP = AdditionalAttributes
  OBJECT = AdditionalAttributesContainer
  Data_Location = "NONE"
  CLASS = "M"
  Mandatory = "TRUE"
  OBJECT = AdditionalAttributeName
  Data_Location = "PGE"
  Mandatory = "TRUE"
  TYPE = "STRING"

```

```

        CLASS = "M"
        NUM_VAL = 1
    END_OBJECT = AdditionalAttributeName
    GROUP = InformationContent
        CLASS = "M"
            OBJECT = ParameterValue
            Data_Location = "PGE"
            Mandatory = "TRUE"
            TYPE = "STRING"
            CLASS = "M"
            NUM_VAL = 1
            END_OBJECT = ParameterValue
        END_GROUP = InformationContent
    END_OBJECT = AdditionalAttributesContainer
END_GROUP = AdditionalAttributes

GROUP = AssociatedPlatformInstrumentSensor
    OBJECT = AssociatedPlatformInstrumentSensorContainer
        CLASS = "1"
        Data_Location = "NONE"
        Mandatory = "FALSE"
            OBJECT = AssociatedSensorShortName
                Data_Location = "PGE"
                CLASS = "1"
                TYPE = "STRING"
                NUM_VAL = 1
                Mandatory = "FALSE"
            END_OBJECT = AssociatedSensorShortName
            OBJECT = AssociatedPlatformShortName
                Data_Location = "PGE"
                CLASS = "1"
                TYPE = "STRING"
                NUM_VAL = 1
                Mandatory = "FALSE"
            END_OBJECT = AssociatedPlatformShortName
            OBJECT = AssociatedInstrumentShortName
                Data_Location = "PGE"
                CLASS = "1"
                TYPE = "STRING"
                NUM_VAL = 1
                Mandatory = "FALSE"
            END_OBJECT = AssociatedInstrumentShortName
        END_OBJECT = AssociatedPlatformInstrumentSensorContainer
    END_GROUP = AssociatedPlatformInstrumentSensor

```

END_GROUP = INVENTORYMETADATA

END

Following is another example of ASCII metadata file created with ASTER L1B swath conversion.

```
GROUP                = INVENTORYMETADATA
GROUPTYPE            = MASTERGROUP

GROUP                = COLLECTIONDESCRIPTIONCLASS

  OBJECT              = SHORTNAME
  NUM_VAL              = 1
  VALUE                = "ASTL1B"
  END_OBJECT          = SHORTNAME

  OBJECT              = VERSIONID
  NUM_VAL              = 1
  VALUE                = "NOT SET"
  END_OBJECT          = VERSIONID

END_GROUP            = COLLECTIONDESCRIPTIONCLASS

GROUP                = ECSDATAGRANULE

  OBJECT              = LOCALGRANULEID
  NUM_VAL              = 1
  VALUE                =
"AST_L1BE_multiband_npr_VNIR_Swath_UTM.tif"
  END_OBJECT          = LOCALGRANULEID

  OBJECT              = PRODUCTIONDATETIME
  NUM_VAL              = 1
  VALUE                = "2004-09-17T19:08:16.000Z"
  END_OBJECT          = PRODUCTIONDATETIME

END_GROUP            = ECSDATAGRANULE

GROUP                = PGEVERSIONCLASS

  OBJECT              = PGEVERSION
```

```

        NUM_VAL          = 1
        VALUE            = "03.00R02"
        END_OBJECT      = PGEVERSION
END_GROUP              = PGEVERSIONCLASS
GROUP                  = SINGLEDATETIME

        OBJECT          = TIMEOFDAY
        NUM_VAL        = 1
        VALUE          = "155308030000Z"
        END_OBJECT    = TIMEOFDAY

        OBJECT          = CALENDARDATE
        NUM_VAL        = 1
        VALUE          = "20020503"
        END_OBJECT    = CALENDARDATE
END_GROUP              = SINGLEDATETIME
GROUP                  = RANGEDATETIME

        OBJECT          = RANGEBEGINNINGTIME
        NUM_VAL        = 1
        VALUE          = "NOT SET"
        END_OBJECT    = RANGEBEGINNINGTIME

        OBJECT          = RANGEBEGINNINGDATE
        NUM_VAL        = 1
        VALUE          = "NOT SET"
        END_OBJECT    = RANGEBEGINNINGDATE

        OBJECT          = RANGEENDINGTIME
        NUM_VAL        = 1
        VALUE          = "NOT SET"
        END_OBJECT    = RANGEENDINGTIME

        OBJECT          = RANGEENDINGDATE
        NUM_VAL        = 1
        VALUE          = "NOT SET"
        END_OBJECT    = RANGEENDINGDATE
END_GROUP              = RANGEDATETIME
GROUP                  = SPATIALDOMAINCONTAINER

```

```

GROUP                = HORIZONTALSPATIALDOMAINCONTAINER

  GROUP              = BOUNDINGRECTANGLE

    OBJECT           = WESTBOUNDINGCOORDINATE
      NUM_VAL        = 1
      VALIDRULE      = "Range (-180.0,+180.0) "
      VALUE          = -77.488089
    END_OBJECT       = WESTBOUNDINGCOORDINATE

    OBJECT           = NORTHBOUNDINGCOORDINATE
      NUM_VAL        = 1
      VALIDRULE      = "Range (-90.0,+90.0) "
      VALUE          = 39.131487
    END_OBJECT       = NORTHBOUNDINGCOORDINATE

    OBJECT           = EASTBOUNDINGCOORDINATE
      NUM_VAL        = 1
      VALIDRULE      = "Range (-180.0,+180.0) "
      VALUE          = -76.498469
    END_OBJECT       = EASTBOUNDINGCOORDINATE

    OBJECT           = SOUTHBOUNDINGCOORDINATE
      NUM_VAL        = 1
      VALIDRULE      = "Range (-90.0,+90.0) "
      VALUE          = 38.474253
    END_OBJECT       = SOUTHBOUNDINGCOORDINATE

  END_GROUP          = BOUNDINGRECTANGLE

END_GROUP            = HORIZONTALSPATIALDOMAINCONTAINER

END_GROUP            = SPATIALDOMAINCONTAINER

GROUP                = INPUTGRANULE

  OBJECT             = INPUTPOINTER
    NUM_VAL          = 1
    VALUE            = "AST_L1BE_003050320021553080000000"
  END_OBJECT         = INPUTPOINTER

END_GROUP            = INPUTGRANULE

GROUP                = ADDITIONALATTRIBUTES

  OBJECT             = ADDITIONALATTRIBUTESCONTAINER

```

```

CLASS                                = "1"

OBJECT                                = ADDITIONALATTRIBUTENAME
  CLASS                               = "1"
  NUM_VAL                             = 1
  VALUE                               = "BANDNUMBER"
END_OBJECT                            = ADDITIONALATTRIBUTENAME

GROUP                                 = INFORMATIONCONTENT
  CLASS                               = "1"

  OBJECT                              = PARAMETERVALUE
    CLASS                             = "1"
    NUM_VAL                           = 1
    VALUE                             = "1"
  END_OBJECT                          = PARAMETERVALUE

END_GROUP                             = INFORMATIONCONTENT

END_OBJECT                            = ADDITIONALATTRIBUTESCONTAINER

OBJECT                                = ADDITIONALATTRIBUTESCONTAINER
  CLASS                               = "2"

  OBJECT                              = ADDITIONALATTRIBUTENAME
    CLASS                             = "2"
    NUM_VAL                           = 1
    VALUE                             = "BANDNUMBER"
  END_OBJECT                          = ADDITIONALATTRIBUTENAME

GROUP                                 = INFORMATIONCONTENT
  CLASS                               = "2"

  OBJECT                              = PARAMETERVALUE
    CLASS                             = "2"
    NUM_VAL                           = 1
    VALUE                             = "1"
  END_OBJECT                          = PARAMETERVALUE

END_GROUP                             = INFORMATIONCONTENT

END_OBJECT                            = ADDITIONALATTRIBUTESCONTAINER

OBJECT                                = ADDITIONALATTRIBUTESCONTAINER
  CLASS                               = "3"

```

```

OBJECT          = ADDITIONALATTRIBUTENAME
  CLASS         = "3"
  NUM_VAL       = 1
  VALUE         = "BANDNUMBER"
END_OBJECT     = ADDITIONALATTRIBUTENAME

GROUP          = INFORMATIONCONTENT
  CLASS         = "3"

  OBJECT        = PARAMETERVALUE
    CLASS       = "3"
    NUM_VAL     = 1
    VALUE       = "1"
  END_OBJECT    = PARAMETERVALUE

END_GROUP      = INFORMATIONCONTENT

END_OBJECT     = ADDITIONALATTRIBUTESCONTAINER

END_GROUP      = ADDITIONALATTRIBUTES

GROUP          = PLATFORMINSTRUMENTSENSOR

  OBJECT        = PLATFORMSHORTNAME
    NUM_VAL     = 1
    VALUE       = "AM-1"
  END_OBJECT    = PLATFORMSHORTNAME

  OBJECT        = INSTRUMENTSHORTNAME
    NUM_VAL     = 1
    VALUE       = "ASTER"
  END_OBJECT    = INSTRUMENTSHORTNAME

END_GROUP      = PLATFORMINSTRUMENTSENSOR

GROUP          = POINTINGANGLES

  OBJECT        = POINTINGANGLESCONTAINER
    CLASS       = "1"

  OBJECT        = SENSORNAME
    CLASS       = "1"
    NUM_VAL     = 1
    VALUE       = "VNIR"
  END_OBJECT    = SENSORNAME

```

```

OBJECT          = POINTINGANGLE
  CLASS         = "1"
  NUM_VAL       = 1
  VALUE         = -20.654000
END_OBJECT      = POINTINGANGLE

OBJECT          = SETTINGTIMEOFPOINTING
  CLASS         = "1"
  NUM_VAL       = 1
  VALUE         = "2002-05-03T15:52:57Z"
END_OBJECT      = SETTINGTIMEOFPOINTING

END_OBJECT      = POINTINGANGLESCONTAINER

END_GROUP       = POINTINGANGLES

GROUP           = PRODUCTSPECIFICMETADATA

OBJECT          = MAPORIENTATIONANGLE
  NUM_VAL       = 1
  VALUE         = 9.818777
END_OBJECT      = MAPORIENTATIONANGLE

OBJECT          = SOLAR_AZIMUTH_ANGLE
  NUM_VAL       = 1
  VALUE         = 140.556708
END_OBJECT      = SOLAR_AZIMUTH_ANGLE

OBJECT          = SOLAR_ELEVATION_ANGLE
  NUM_VAL       = 1
  VALUE         = 61.909232
END_OBJECT      = SOLAR_ELEVATION_ANGLE

END_GROUP       = PRODUCTSPECIFICMETADATA

GROUP           = GRID_INFO

GROUP           = PROJECTION_INFO

OBJECT          = PROJECTION
  NUM_VAL       = 1
  VALUE         = "UNIVERSAL TRANSVERSE MERCATOR"
END_OBJECT      = PROJECTION

OBJECT          = PROJECTIONPARAMETERS
  NUM_VAL       = 13

```

```

VALUE = (0.000000, 0.000000, 0.000000,
0.000000, 0.000000, 0.000000, 0.000000, 0.000000, 0.000000,
0.000000, 0.000000, 0.000000, 0.000000)
END_OBJECT = PROJECTIONPARAMETERS

OBJECT = DATUM
NUM_VAL = 1
VALUE = "WGS 1984"
END_OBJECT = DATUM

OBJECT = UTMZONE
NUM_VAL = 1
VALUE = 18
END_OBJECT = UTMZONE

END_GROUP = PROJECTION_INFO

GROUP = GRIDSTRUCTUREINFO

OBJECT = GRIDRESAMPLINGMETHOD
NUM_VAL = 1
VALUE = "Nearest neighbor resampling"
END_OBJECT = GRIDRESAMPLINGMETHOD

OBJECT = DATACOLUMNS
NUM_VAL = 1
VALUE = 5622
END_OBJECT = DATACOLUMNS

OBJECT = DATAROWS
NUM_VAL = 1
VALUE = 4987
END_OBJECT = DATAROWS

OBJECT = UPPERLEFTCORNER
NUM_VAL = 2
VALUE = (284937.415469, 4334316.023925)
END_OBJECT = UPPERLEFTCORNER

OBJECT = LOWERRIGHTCORNER
NUM_VAL = 2
VALUE = (369286.756930, 4259500.068986)
END_OBJECT = LOWERRIGHTCORNER

OBJECT = CORNERCOORDINATEUNITS
NUM_VAL = 1

```

```

VALUE          = "Meters"
END_OBJECT    = CORNERCOORDINATEUNITS

GROUP         = RESOLUTION

OBJECT        = XPIXELSIZE
  NUM_VAL     = 1
  VALUE       = 15.003440
END_OBJECT    = XPIXELSIZE

OBJECT        = YPIXELSIZE
  NUM_VAL     = 1
  VALUE       = 15.002197
END_OBJECT    = YPIXELSIZE

OBJECT        = XYPIXELSIZEUNIT
  NUM_VAL     = 1
  VALUE       = "Meters"
END_OBJECT    = XYPIXELSIZEUNIT

END_GROUP     = RESOLUTION

END_GROUP     = GRIDSTRUCTUREINFO

END_GROUP     = GRID_INFO

END_GROUP     = INVENTORYMETADATA

END

```

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Appendix A. List of Supported Products

The HDFEOS products listed below have been successfully tested with the HDFEOS to GeoTiff Conversion Tool (HEG). Additional products will be added to this list as they are released to the public and tested.

Note that there may be additional products which have not yet been tested, but which are supported by HEG due to their similarities to products below. Please contact the HEG development team if you encounter problems using HEG with the data products below or with any similar products.

MISR Products: (versions 1, 2, and 3)

Level 1B

MI1B2E = MISR Level 1B2 Ellipsoid Data

MI1B2T = MISR Level 1B2 Terrain Data

Level 2

MIL2ASLS = MISR Level 2 Surface parameters

MIL2ASAE = MISR Level 2 Aerosol parameters

MIL2TCAL = MISR Level 2 TOA/Cloud Albedo parameters

Level 3

MIL3MRD = MISR Level 3 Component Global Radiance Product covering a month

MIL3QRD = MISR Level 3 Component Global Radiance Product covering a quarter (seasonal)

MIL3YRD = MISR Level 3 Component Global Radiance Product covering a year

MIL3MAE = MISR Level 3 Component Global Aerosol Product covering a month

MIL3QAE = MISR Level 3 Component Global Aerosol Product covering a quarter (seasonal)

MIL3YAE = MISR Level 3 Component Global Aerosol Product covering a year

MIL3MLS = MISR Level 3 Component Global Land Product covering a month

MIL3QLS = MISR Level 3 Component Global Land Product covering a quarter (seasonal)

MIL3YLS = MISR Level 3 Component Global Land Product covering a year

MIL3DRD = MISR Level 3 Component Radiance Land Product covering a day

MIL3DAE = MISR Level 3 Component Global Aerosol Product covering a day

MIL3DLS = MISR Level 3 Component Global Land Product covering a day

ASTER Products: (versions 3 and 4)

Level 1B

AST_L1B = ASTER Level 1B Registered Radiance at Sensor

Level 2

AST_04 = ASTER On-Demand L2 Brightness Temperature at the Sensor

AST_05 = ASTER On-Demand L2 Surface Emissivity
AST_06V = ASTER L2 Decorrelation Stretch VNIR
AST_06S = ASTER L2 Decorrelation Stretch SWIR
AST_06T = ASTER L2 Decorrelation Stretch TIR
AST_07 = ASTER On-Demand L2 Surface Reflectance SWIR and VNIR
AST_08 = ASTER On-Demand L2 Surface Kinetic Temperature
AST_09 = ASTER On-Demand L2 Surface Radiance SWIR and VNIR
AST_09T = ASTER On-Demand L2 Surface Radiance TIR
AST_07XT = ASTER On-Demand L2 Surface Reflectance VNIR
AST_09XT = ASTER On-Demand L2 Surface Radiance VNIR

ASTER Level 3 DEM Product

AST14DEM = ASTER Digital Elevation Model

MODIS Products: (versions 3 and 4)

Note: For many MODIS/Terra products shown below (e.g., MOD10A1), the corresponding MODIS/Aqua product (e.g., MYD10A1) has not been formally tested with HEG, but is likely to work. Please contact the HEG development team if you find problems with HEG processing of MODIS/Aqua data products, which are similar to the supported MODIS/Terra products below.

Level 1

MOD021KM = MODIS/Terra Calibrated Radiances 5-Min L1B Swath 1km
MOD02HKM = MODIS/Terra Calibrated Radiances 5-Min L1B Swath 500m
MOD02QKM = MODIS/Terra Calibrated Radiances 5-Min L1B Swath 250m
MOD03 = MODIS/Terra Geolocation Fields 5-Min L1A Swath 1km

Level 2 MODIS Oceans

MODOCL2 = MODIS/Terra Ocean Color Radiance Products 5-Min L2 Swath 1km Day
MODOCL2A = MODIS/Terra Ocean Color Derived Products Group 1 5-Min L2 Swath 1km Day
MODOCL2B = MODIS/Terra Ocean Color Derived Products Group 2 5-Min L2 Swath 1km Day
MODOCQC = MODIS/Terra Ocean Color QC Products 5-Min L2 Swath 1km Day
MOD28L2 = MODIS/Terra Sea Surface Temperature Products 5-Min L2 Swath 1km
MOD28QC = MODIS/Terra Sea Surface Temperature QC Products 5-Min L2 Swath 1km

Level 2 MODIS Atmosphere and Land

MOD04_L2 = MODIS/Terra Aerosol 5-Min L2 Swath 10km
MOD05_L2 = MODIS/Terra Total Precipitable Water Vapor 5-Min L2 Swath 1km and 5km
MOD06_L2 = MODIS/Terra Clouds 5-Min L2 Swath 1km and 5km
MOD07_L2 = MODIS Temperature and Water Vapor Profile Product
MOD09GQK = MODIS/Terra Surface Reflectance Daily L2G Global 250m SIN Grid
MOD09GHK = MODIS/Terra Surface Reflectance Daily L2G Global 500m SIN Grid

MOD09GST = MODIS/Terra Surface Reflectance Quality Daily L2G Global 1km SIN Grid
MOD10_L2 = MODIS/Terra Snow Cover 5-Min L2 Swath 500m
MOD11_L2 = MODIS/Terra Land Surface Temperature/Emissivity 5-Min L2 Swath 1km
MOD29 = MODIS/Terra Sea Ice Extent 5-Min L2 Swath 1km
MOD35 = MODIS/Terra Cloud Mask and Spectral Test Results 5-Min L2 Swath 250m and 1km

Level 3

MOD08_D3 = MODIS/Terra Aerosol Cloud Water Vapor Ozone Daily L3 Global 1Deg CMG
MOD08_E3 = MODIS/Terra Aerosol Cloud Water Vapor Ozone 8-Day L3 Global 1Deg CMG
MOD08_M3 = MODIS/Terra Aerosol Cloud Water Vapor Ozone Monthly L3
Global 1Deg CMG
MOD09A1 = MODIS/Terra Surface Reflectance 8-Day L3 Global 500m SIN Grid
MYD09A1 (version 4 only) = MODIS/Aqua Surface Reflectance 8-Day L3 Global 500m SIN
Grid
MOD09Q1 = MODIS/Terra Surface Reflectance 8-Day L3 Global 250m SIN Grid
MOD10A1 = MODIS/Terra Snow Cover Daily L3 Global 500m SIN Grid
MOD10A2 = MODIS/Terra Snow Cover 8-Day L3 Global 500m SIN Grid
MOD10C1 = MODIS/Terra Snow Cover Daily L3 Global 0.05 Deg CMG
MYD10C1 = MODIS/Aqua Snow Cover Daily L3 Global 0.05 Deg CMG
MOD10C2 = MODIS/Terra Snow Cover 8-Day L3 Global 0.05 Deg CMG
MYD10C2 = MODIS/Aqua Snow Cover 8-Day L3 Global 0.05 Deg CMG
MOD11A1 = MODIS/Terra Land Surface Temperature/Emissivity Daily L3 Global 1km SIN Grid
MYD11A1 (version 4 only) = MODIS/Aqua Land Surface Temperature/Emissivity Daily L3
Global 1km SIN Grid
MOD11A2 = MODIS/Terra Land Surface Temperature/Emissivity 8-Day L3 Global 1km SIN Grid
MOD12Q1 = MODIS/Terra Land Cover Type Yearly L3 Global 1km SIN Grid
MOD13A1 = MODIS/Terra Vegetation Indices 16-Day L3 Global 500m SIN Grid
MYD13A1 (version 4 only) = MODIS/Aqua Vegetation Indices 16-Day L3 Global 500m SIN
Grid
MOD13A2 = MODIS/Terra Vegetation Indices 16-Day L3 Global 1km SIN Grid
MYD13A2 (version 4 only) = MODIS/Aqua Vegetation Indices 16-Day L3 Global 1km SIN
Grid
MOD13Q1 = MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid
MYD13Q1 (version 4 only) = MODIS/Aqua Vegetation Indices 16-Day L3 Global 250m SIN
Grid
MOD14A1 = MODIS/Terra Thermal Anomalies/Fire Daily L3 Global 1km SIN Grid
MOD14A2 = MODIS/Terra Thermal Anomalies/Fire 8-Day L3 Global 1km SIN Grid
MOD15A2 = MODIS/Terra Leaf Area Index/FPAR 8-Day L4 Global 1km SIN Grid
MOD17A2 = MODIS/Terra Net Photosynthesis 8-Day L4 Global 1km SIN Grid
MOD29P1D = MODIS/Terra Sea Ice Extent Daily L3 Global 1km EASE-Grid Day
MOD29P1N = MODIS/Terra Sea Ice Extent Daily L3 Global 1km EASE-Grid Night
MOD43B1 = MODIS/Terra BRDF/Albedo Model-1 16-Day L3 Global 1km SIN Grid
MOD43B3 = MODIS/Terra Albedo 16-Day L3 Global 1km SIN Grid
MOD43B4 = MODIS/Terra Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 1km SIN Grid

Level 3 (maps) OCEAN products

MO04MD = MODIS/Terra Ocean Color and SST Mean Maps Daily L3 Global 4km CylEqDis
MO04QD = MODIS/Terra Ocean Color and SST Quality Maps Daily L3 Global 4km CylEqDis
MO04MW = MODIS/Terra Ocean Color and SST Mean Maps 8-Day L3 Global 4km CylEqDis
MO04QW = MODIS/Terra Ocean Color and SST Quality Maps 8-Day L3 Global 4km
CylEqDis
MO1DMW = MODIS/Terra Ocean Color and SST Mean Maps 8-Day L3 Global 1Deg
CylEqDis
MO1DQW = MODIS/Terra Ocean Color and SST Quality Maps 8-Day L3 Global 1Deg
CylEqDis
MO36MD = MODIS/Terra Ocean Color and SST Mean Maps Daily L3 Global 36km CylEqDis
MO36QD = MODIS/Terra Ocean Color and SST Quality Maps Daily L3 Global 36km
CylEqDis

Level 3 MODIS Land Products

MOD43C1 = MODIS/Terra Albedo 16-Day L3 Global 0.05Deg CMG
MOD43C2 = MODIS/Terra BRDF/Albedo Parameters 16-Day L3 Global 0.05Deg CMG
MOD43C3 = MODIS/Terra Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 0.05Deg
CMG
MCD43C1 = MODIS/Terra+Aqua Albedo 16-Day L3 Global 0.05Deg CMG
MCD43C2 = MODIS/Terra+Aqua BRDF/Albedo Parameters 16-Day L3 Global 0.05Deg CMG
MCD43C3 = MODIS/Terra+Aqua Nadir BRDF-Adjusted Reflectance 16-Day L3 Global
0.05Deg CMG
MOD12C1 = MODIS/Terra Land Cover Type Yearly L3 Global 0.05Deg CMG
MYD12C1 = MODIS/Aqua Land Cover Type Yearly L3 Global 0.05Deg CMG

AMSR-E Products: (version 1)

Level 2

AE_Ocean = AMSR-E/Aqua L2B Global Swath Ocean Products derived from Wentz Algorithm
AE_Rain = AMSR-E/Aqua L2B Global Swath Rain Rate/Type GSFC Profiling Algorithm

Level 2A

AE_L2A = AMSR-E/Aqua L2A Global Swath Spatially Resampled Brightness Temperatures
(Tb)

Level 3

AE_DyOcn = AMSR-E/Aqua Daily L3 Global Ascending/Descending .25x.25 deg Ocean Grids
AE_WkOcn = AMSR-E/Aqua Weekly L3 Global Ascending/Descending .25x.25 deg Ocean
AE_MoOcn = AMSR-E/Aqua Monthly L3 Global Ascending/Descending .25x.25 deg Ocean
Grids
AE_DySno = AMSR-E/Aqua Daily L3 Global Snow Water Equivalent EASE-Grids
AE_5DSno = AMSR-E/Aqua 5 Day L3 Global Snow Water Equivalent EASE-Grids
AE_MoSno = AMSR-E/Aqua Monthly L3 Global Snow Water Equivalent EASE-Grids
AE_SII2 = AMSR-E/Aqua daily L3 12.5 km Tb, Sea Ice Conc., & Snow Depth Polar Grids

AE_SI6 = AMSR-E/Aqua Daily L3 6.25 km 89 GHz Brightness Temperature (Tb) Polar Grids
AE_RnGd = AMSR-E/Aqua Monthly L3 5x5 deg Rainfall Accumulations

AIRS Products: (version 2 and 3)

Note: AIRS products have been tested with some, but not all fields. Please contact the HEG development team if you find problems with HEG processing of AIRS products.

Level 1B

AIRABRAD = AIRS AMSU-A1 & AMSU-A2 combined, geolocated & calibrated brightness temperatures

AIRHBRAD = HSB geolocated & calibrated brightness temperatures

AIRIBRAD = AIRS Level 1B IR geolocated radiances

AIRIBQAP = AIRS Level 1B Quality Assurance Product

AIRVBRAD = AIRS Vis/Near IR geolocated radiances

AIRVBQAP = AIRS Vis/Near IR Quality Assurance Product

Level 2

AIRI2CCF = L2 Cloud Cleared Radiance Product (AIRS/AMSU-A/HSB)

AIRX2RET = L2 Standard Retrieval Product (AIRS/AMSU-A/HSB)

AIRX2SUP = L2 Support Product (AIRS/AMSU-A/HSB)

Level 3

AIRXSTD = AIRS Level 3 Daily Standard Physical Retrieval Product

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Appendix B. State Plane Zones and Values

NAD83 = North American Datum 1983

NAD27 = North American Datum 1927

NAD83 Alaska Zone 1 = 5001

NAD83 Alaska Zone 2 = 5002

NAD83 Alaska Zone 3 = 5003

NAD83 Alaska Zone 4 = 5004

NAD83 Alaska Zone 5 = 5005

NAD83 Alaska Zone 6 = 5006

NAD83 Alaska Zone 7 = 5007

NAD83 Alaska Zone 8 = 5008

NAD83 Alaska Zone 9 = 5009

NAD83 Alaska Zone 10 = 5010

NAD83 Alabama East = 0101

NAD83 Alabama West = 0102

NAD83 Arizona East = 0201

NAD83 Arizona Central = 0202

NAD83 Arizona West = 0203

NAD83 Arkansas North = 0301

NAD83 Arkansas South = 0302

NAD83 California Zone 1 = 0401

NAD83 California Zone 2 = 0402

NAD83 California Zone 3 = 0403

NAD83 California Zone 4 = 0404

NAD83 California Zone 5 = 0405

NAD83 California Zone 6 = 0406

NAD83 Colorado North = 0501

NAD83 Colorado Central = 0502

NAD83 Colorado South = 0503

NAD83 Connecticut = 0600

NAD83 Delaware = 0700

NAD83 Florida East = 901

NAD83 Florida West = 902

NAD83 Florida North = 903

NAD83 Georgia East = 1001

NAD83 Georgia West = 1002

NAD83 Hawaii Zone 1 = 5101

NAD83 Hawaii Zone 2 = 5102

NAD83 Hawaii Zone 3 = 5103

NAD83 Hawaii Zone 4 = 5104

NAD83 Hawaii Zone 5 = 5105

NAD83 Idaho East = 1101
NAD83 Idaho Central = 1102
NAD83 Idaho West = 1103
NAD83 Illinois East = 1201
NAD83 Illinois West = 1202
NAD83 Indiana East = 1301
NAD83 Indiana West = 1302
NAD83 Iowa North = 1401
NAD83 Iowa South = 1402
NAD83 Kansas North = 1501
NAD83 Kansas South = 1502
NAD83 Kentucky North = 1601
NAD83 Kentucky South = 1602
NAD83 Louisiana North = 1701
NAD83 Louisiana South = 1702
NAD83 Maine East = 1801
NAD83 Maine West = 1802
NAD83 Maryland = 1900
NAD83 Massachusetts = 2001
NAD83 Massachusetts Island = 2002
NAD83 Michigan North = 2111
NAD83 Michigan Central = 2112
NAD83 Michigan South = 2113
NAD83 Minnesota North = 2201
NAD83 Minnesota Central = 2202
NAD83 Minnesota South = 2203
NAD83 Mississippi East = 2301
NAD83 Mississippi West = 2302
NAD83 Missouri East = 2401
NAD83 Missouri Central = 2402
NAD83 Missouri West = 2403
NAD83 Montana = 2500
NAD27 Montana North = 2501
NAD27 Montana Central = 2502
NAD27 Montana South = 2503
NAD83 Nebraska = 2600
NAD27 Nebraska North = 2601
NAD27 Nebraska South = 2602
NAD83 Nevada East = 2701
NAD83 Nevada Central = 2702
NAD83 Nevada West = 2703
NAD83 New Hampshire = 2800
NAD83 New Jersey = 2900
NAD83 New Mexico East = 3001
NAD83 New Mexico Central = 3002

NAD83 New Mexico West = 3003
NAD83 New York East = 3101
NAD83 New York Central = 3102
NAD83 New York West = 3103
NAD83 New York Long Island = 3104
NAD83 North Carolina = 3200
NAD83 North Dakota North = 3301
NAD83 North Dakota South = 3302
NAD83 Ohio North = 3401
NAD83 Ohio South = 3402
NAD83 Oklahoma North = 3501
NAD83 Oklahoma South = 3502
NAD83 Oregon North = 3601
NAD83 Oregon South = 3602
NAD83 Pennsylvania North = 3701
NAD83 Pennsylvania South = 3702
NAD83 Rhode Island = 3800
NAD83 South Carolina = 3900
NAD27 South Carolina North = 3901
NAD27 South Carolina South = 3902
NAD83 South Dakota North = 4001
NAD83 South Dakota South = 4002
NAD83 Tennessee = 4100
NAD83 Texas North = 4201
NAD83 Texas North Central = 4202
NAD83 Texas Central = 4203
NAD83 Texas South Central = 4204
NAD83 Texas South = 4205
NAD83 Utah North = 4301
NAD83 Utah Central = 4302
NAD83 Utah South = 4303
NAD83 Vermont = 4400
NAD83 Virginia North = 4501
NAD83 Virginia South = 4502
NAD83 Washington North = 4601
NAD83 Washington South = 4602
NAD83 West Virginia North = 4701
NAD83 West Virginia South = 4702
NAD83 Wisconsin North = 4801
NAD83 Wisconsin Central = 4802
NAD83 Wisconsin South = 4803
NAD83 Wyoming East = 4901
NAD83 Wyoming East Central = 4902
NAD83 Wyoming West Central = 4903
NAD83 Wyoming West = 4904

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