

This page intentionally left blank.

Preface

The Synergy program, under the auspices of NASA's Earth Observing System Program, is providing 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 is to provide conversion for standard science products produced by the MODIS, MISR and ASTER instruments. 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.

Technical Points of Contact within EOS are:

Larry Klein, larry@eos.east.hitc.com

Abe Taaheri, ataaheri@eos.east.hitc.com

Cid Praderas, cpradera@eos.east.hitc.com

Ray Milburn, ray@eos.east.hitc.com

An email address has been provided for user help:

pgstlkit@eos.east.hitc.com

Any questions should be addressed to:

Data Management Office
The ECS Project Office
Raytheon Systems Company
1616 McCormick Drive
Upper Marlboro, MD 20774-5301

This page intentionally left blank.

Abstract

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

Keywords: HDF-EOS, GeoTIFF, GIS

This page intentionally left blank.

Contents

PREFACE.....	III
ABSTRACT	V
CONTENTS	VII
1. INTRODUCTION.....	1
1.1 IDENTIFICATION.....	1
1.2 SCOPE	1
1.3 PURPOSE AND OBJECTIVES	1
1.4 STATUS AND SCHEDULE.....	1
1.5 DOCUMENT ORGANIZATION	1
2. RELATED DOCUMENTATION	1
2.1 PARENT DOCUMENTS.....	1
2.2 RELATED DOCUMENTS	1
4. DOWNLOAD AND BUILD INSTRUCTIONS.....	1
4.1 DOWNLOAD INSTRUCTIONS	1
4.2 INSTALL INSTRUCTIONS	2
5. HEG GRAPHICAL USER INTERFACE	1
5.1 HEG FILE CONVERSION WINDOW	1
<u>Menu Bar</u>	2
<u>Left Panel</u>	3
<u>Center Panel</u>	4
<u>Right Panel</u>	6
5.2 HDF-EOS STITCH/SUBSET WINDOW	6
<u>Menu Bar</u>	7
<u>Left Panel</u>	7
<u>Center Panel</u>	8
<u>Right Panel</u>	8
5.3 EXAMPLES OF USAGE	9
5.3.1 Grid Conversion	9
5.3.2 Swath Conversion	13
5.3.3 HEG Stitch/Subset Tool Examples	15
5.3.4 Grid Stitch/Subset	15
5.3.5 Swath Stitch/Subset	18
6. SOFTWARE ARCHITECTURE	1
6.1 HDF-EOS TO GeOTIFF CONVERTER	1
6.2 HEG SUBSET/STITCH TOOL	3
7. COMMAND LINE INTERFACE	1
7.1 INTRODUCTION.....	1

7.2 HEGTOOL.....	1
7.2.1 hegtool Usage	1
7.2.2 Format of Header File	1
7.2.3 An Example of a HegHdr.hdr File	4
7.2.4 Header File Data Ordering.....	7
7.2.5 Reading the Header File	7
7.3 GDTIF.....	7
7.3.1 gdtif Usage	8
7.3.2 Parameter Files	8
7.3.3 Parameter File Format	8
7.3.4 Sample of a Parameter File for gdtif	10
7.4 RESAMPLE.....	11
7.4.1 resample Usage	11
7.4.2 Parameter File Format	11
7.4.3 Sample of a Parameter File for resample	14
7.5 SWTIF.....	14
7.5.1 swtif Usage	15
7.5.2 Parameter File Format	15
7.5.3 An Example of a Parameter File for swtif	16
7.6 SWATH SUBSET/STITCH.....	17
7.6.1 Program subset_stitch_swath Usage	17
7.6.2 Parameter File Format	17
7.6.3 An Example of a Parameter File for subset_stitch_swath	19
7.7 GRID SUBSET/STITCH.....	20
7.7.1 Program subset_stitch_grid Usage	20
7.7.2 Parameter File Format	20
7.7.3 An Example of a Parameter File for subset_stitch_grid	22
7.8 SUBSAMPLE_GRID.....	23
7.8.1 Program subsample_grid usage	23
7.8.2 Parameter File Format	23
7.8.3 Example Parameter Files for subsample_grid	26
8. OUTPUT DATA FORMATS	28
8.1 RAW BINARY FILE DESCRIPTION.....	28
8.1.1 Binary File Description	28
8.1.2 Header File	28
8.1.3 Reading the Binary File	31
8.2 ASCII METADATA.....	32
APPENDIX A. INITIAL LIST OF PRODUCTS TESTED	1

FIGURES

<i>Figure 5.1: HEG Conversion Window</i>	1
<i>Figure 5.2: File Chooser Window</i>	2
<i>Figure 5.3: Subsampling Dialogue Window</i>	4
<i>Figure 5.4: HEG Projection Parameters Window</i>	5
<i>Figure 5.5: HEG HDF-EOS Stitch/Subset Window</i>	6
<i>Figure 5.5: Objects Combo Box</i>	9
<i>Figure 5.6: Fields List</i>	10
<i>Figure 5.7: Spatial Subset Area</i>	11
<i>Figure 5.8: GeoTIFF Conversion Window Containing Example</i>	12
<i>Figure 5.9: Swath Example</i>	14

<i>Figure 5.10: No match warning</i>	<i>15</i>
<i>Figure 5.11: Grid Stitch/Subset example</i>	<i>17</i>

1. Introduction

1.1 Identification

The HDF-EOS Data Format Converter Users Guide was prepared under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-60000).

1.2 Scope

This document is a users' guide for the HDF-EOS to GeoTIFF (HEG) software.

1.3 Purpose and Objectives

This document will provide a user with a description of the functionality implemented by the HEG software. The document describes usage of the 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 interface.

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)

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. Initial target list of data sets

2. Related Documentation

2.1 Parent Documents

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

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-CD-605-001	Release 6A SCF Toolkit Users Guide for the ECS Project
170-TP-605-001	HDF-EOS Library User's Guide Volume 1: Overview and Examples
170-TP-606-001	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

3. Operations Concept

EOS Terra, launched in December 1999, carries 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, but in 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 Format Conversion Tool will allow a user working on his/her workstation to reformat, re-project and perform operations such as subsetting and stitching 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. 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. Processes files will contain original and new metadata, so that they can be re-ingested into ECS archives.

HEG is built in C and Java, built with both a GUI and a command line interface.

The HDF-EOS Format 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 and Windows platforms.

4. Download and Build instructions

4.1 Download Instructions

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

hegSGI.tar.Z - built on SGI Irix 6.5
hegSUN.tar.Z - built on Sun Solaris 2.5
hegLNX.tar.Z - built on Linux Red Hat 7.2
hegWIN.zip built on PC with Windows 98

All Java code built using Java Version 1.2. Java 1.2 will therefore be required to run HEG. (Note: HEG will run on Java 1.3, but there may be some display problems)

To begin download, type:

```
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 HEG_Tool
```

Get the tar file you need:

```
ftp> binary  
ftp> get hegSGI.tar.Z  
OR  
ftp> get hegSUN.tar.Z  
OR  
ftp> get hegLNX.tar.Z  
OR  
ftp> get heg.zip
```

```
ftp> bye
```

This completes downloading the HEG tar files.

4.2 Install Instructions

4.2.1 Installation on SUN/SGI/Linux

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>.tar .
```

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

```
uncompress hegSGI.tar.Z  
tar xvf hegSGI.tar  
OR  
uncompress hegSUN.tar.Z  
tar xvf hegSUN.tar  
OR  
tar xZvf hegLNX.tar.Z
```

```
cd bin  
HEG
```

HEG has been installed and should be running

4.2.2 Installation on Win98/NT/2000

1. Install java (jdk1.2.2 or newer windows version).
2. Put the hegWIN.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

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.

5.1 HEG File Conversion Window

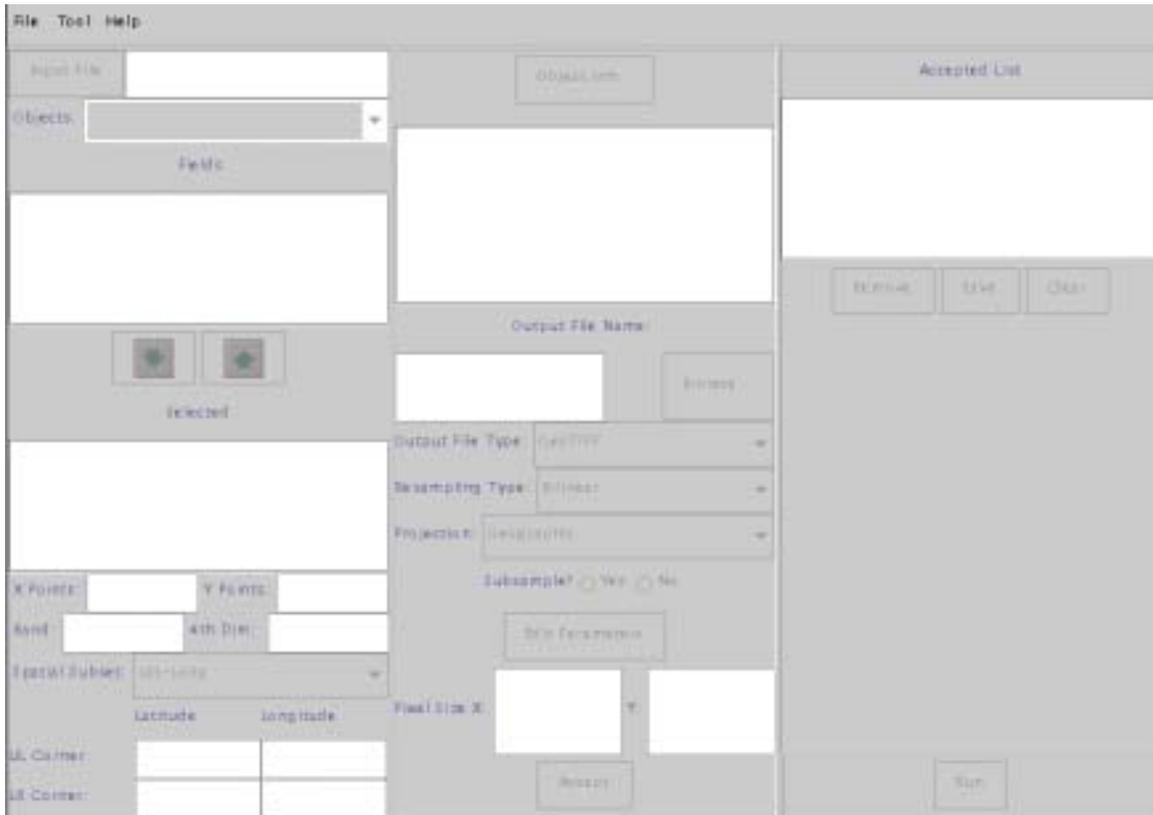


Figure 5.1: HEG Conversion Window

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 chooser 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.

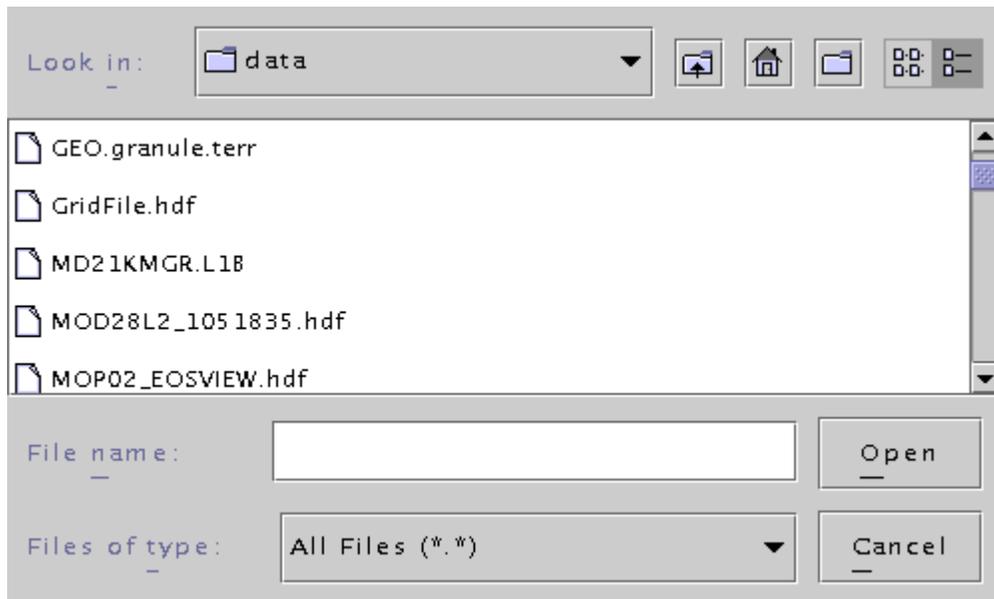


Figure 5.2: File Chooser Window

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 deselected 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 selected is a Swath the x-points and y-points fields will be used. This allows the user to select how many rows and columns to appear in the newly created file. Once a field is selected the default values are placed in the text fields labeled “X Points:” and “Y Points”. The user may edit these values.

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 placing a comma-separated list of dimension numbers in this field. For example, if the third dimension contains 9 datasets and the user wishes to place the dimensions 1, 3, and 5 in the same GeoTIFF file the user would enter “1,3,5” in the band field.

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.

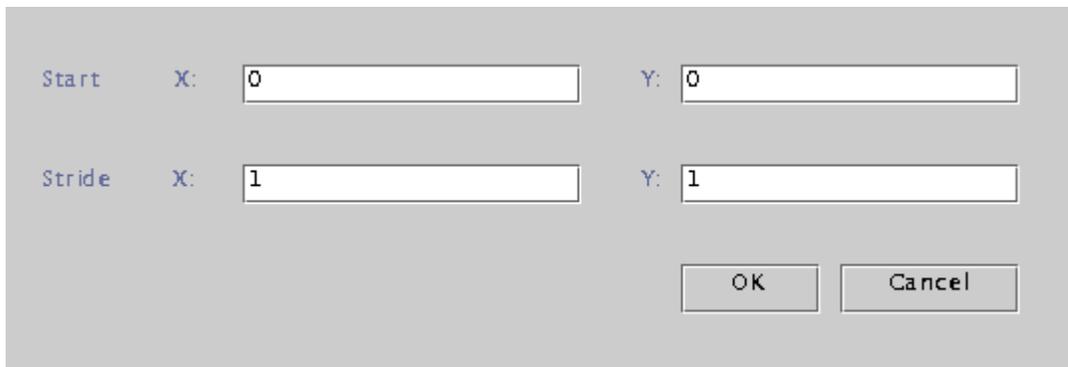
The output file name will appear in the text field labeled “Output File Name”. This field is filled with a default once a field is selected. This field is editable so the user may just type in the file name as desired. This may also be edited by pressing the “Browse” button. Pressing the browse button will cause a file chooser 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, non-standard Binary, HDF-EOS or Multi-Band GeoTIFF. This action is performed by pressing on the combo box labeled “Output File Type”.

Some objects (i.e. 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”.

The output projection type may be selected for some objects (Grid). In version 1.0, the options are: Geographic, Polar Stereographic, Universal Transverse Mercator, Space Oblique Mercator, and Transverse Mercator. 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).



The image shows a dialog box titled "Subsampling Dialogue Window". It has a light gray background. At the top left, the word "Start" is written in blue. To its right, there are two input fields: "X:" followed by a text box containing the number "0", and "Y:" followed by a text box containing the number "0". Below this, the word "Stride" is written in blue. To its right, there are two input fields: "X:" followed by a text box containing the number "1", and "Y:" followed by a text box containing the number "1". At the bottom right of the dialog, there are two buttons: "OK" and "Cancel".

Figure 5.3: Subsampling Dialogue 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.

SMajor	SMinor	disabled
0.0	0.0	0.0
disabled	LongPol	TrueScale
0.0	0.0	0.0
FE	FN	disabled
0.0	0.0	0.0
disabled	disabled	disabled
0.0	0.0	0.0
disabled	disabled	disabled
0.0	0.0	0.0

OK Cancel

Figure 5.4: HEG Projection Parameters Window

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.

For 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:”

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 chooser 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.

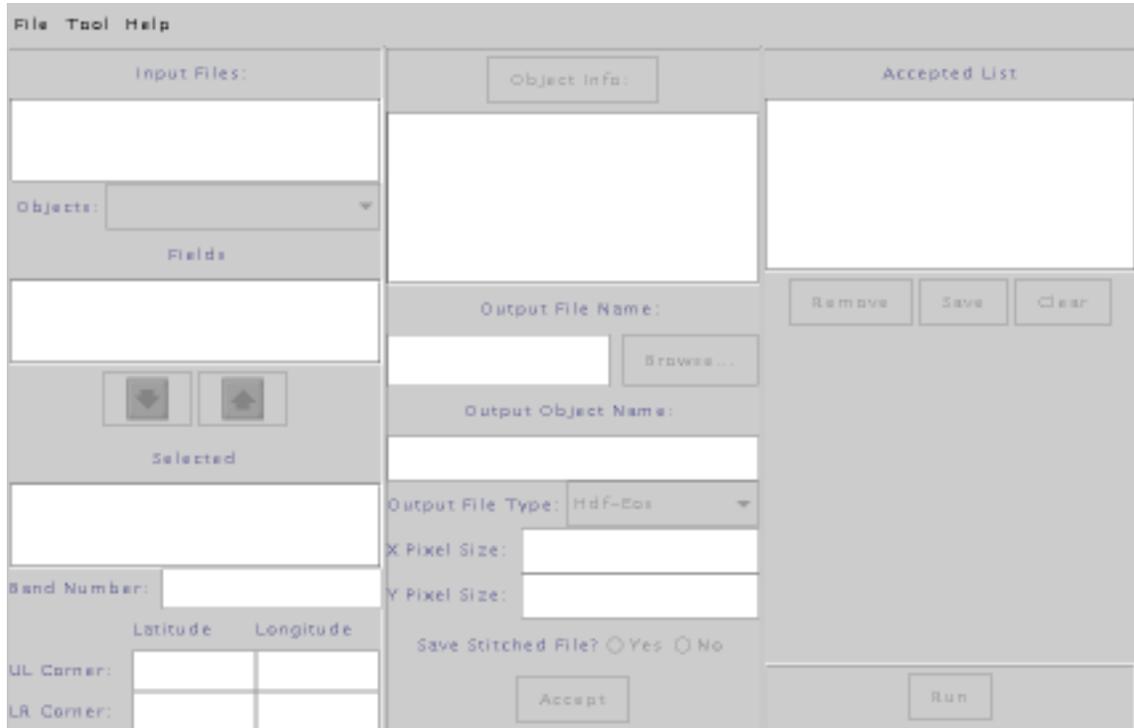


Figure 5.5: HEG HDF-EOS Stitch/Subset Window

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 chooser 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 subsetting. 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 subsetting 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.

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 chooser 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 subsetting 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 non-standard Binary, or HDF-EOS. This may be performed by pressing on the combo box labeled “Output File Type”.

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 chooser 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 objects 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 build 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 chooser 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.h20.v11.001.2000253195532.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 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 5.6)

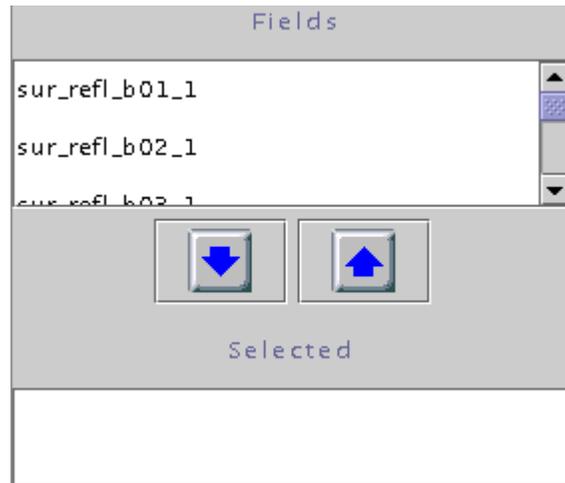


Figure 5.7: Fields List

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)

Spatial Subset:	Lat-Long ▼	
	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 chooser 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 three options for output file type: GeoTIFF, Binary, HDF-EOS, or Multi-Band GeoTIFF.

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, Space Oblique Mercator, or Transverse Mercator. 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.

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. 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.

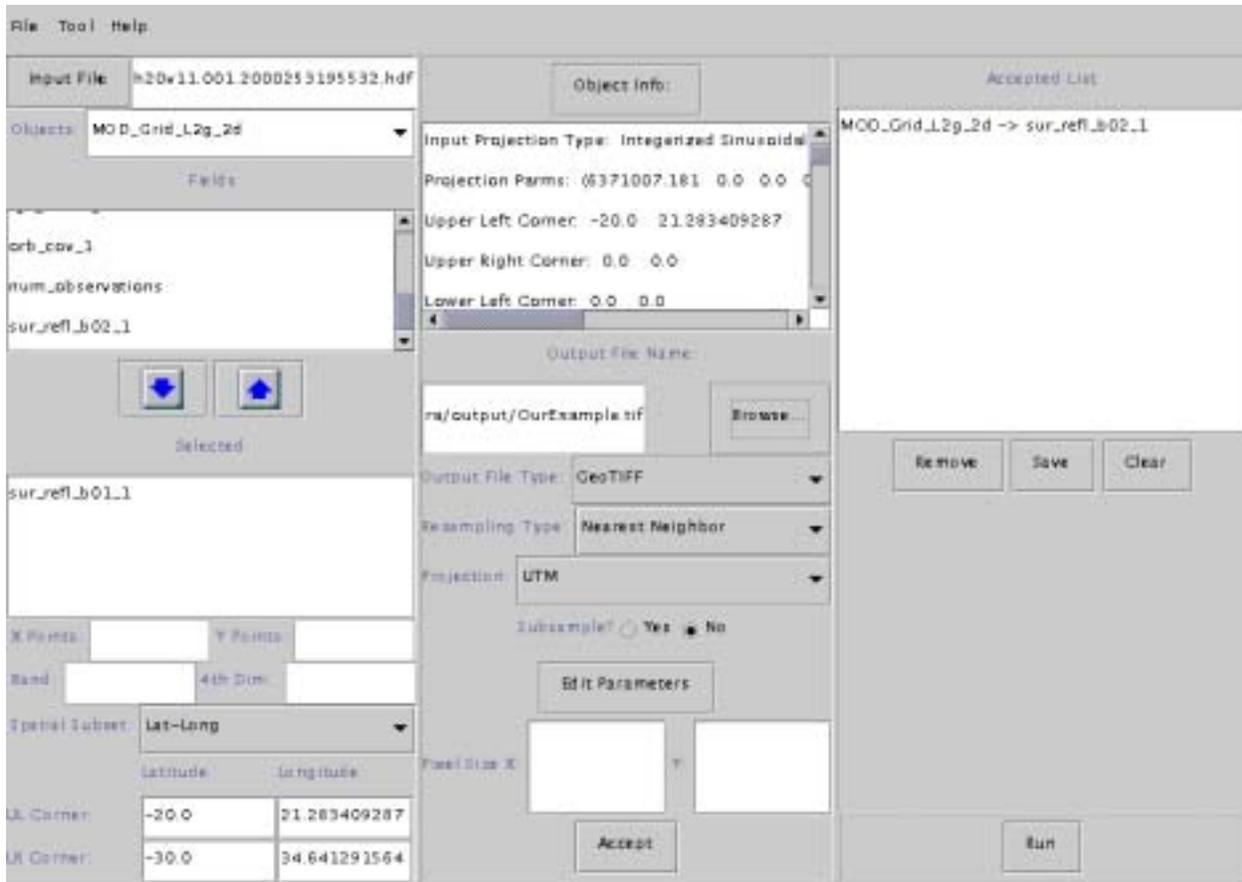


Figure 5.9: GeoTIFF Conversion Window Containing Example

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 chooser 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 chooser 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. In the case of this example, the file `AST_L1BE002062420010942260000000.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 three 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 first option that the user may alter is the number of points to be written in the X and Y directions in the new file. This is a way of controlling the pixel size for swath data. The default values are filled into the fields, although the user may edit them as desired.

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 chooser 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 three options for output file type: GeoTIFF, Binary, HDF-EOS, or Multi-Band GeoTIFF.

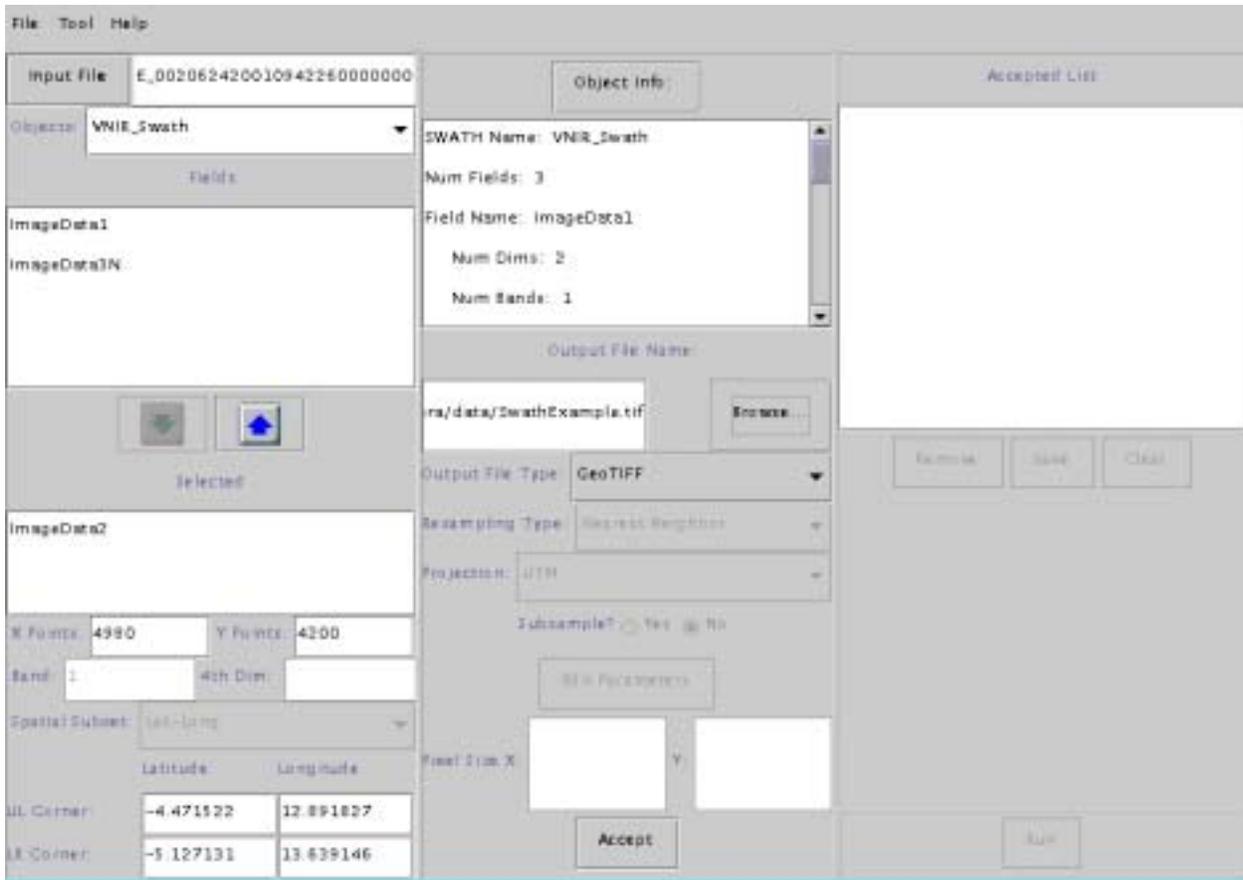


Figure 5.10: Swath Example

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, 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.

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 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 chooser 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 HDF-EOS or to non-standard binary. The user could then take the HDF-EOS file and convert that to GeoTIFF format. 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 chooser to appear. The user may browse through the file structure and pick the desired file. Pressing the “Open” button in the file chooser 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 as with a right 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 chooser 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 Hdf-Eos or Binary.

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?”

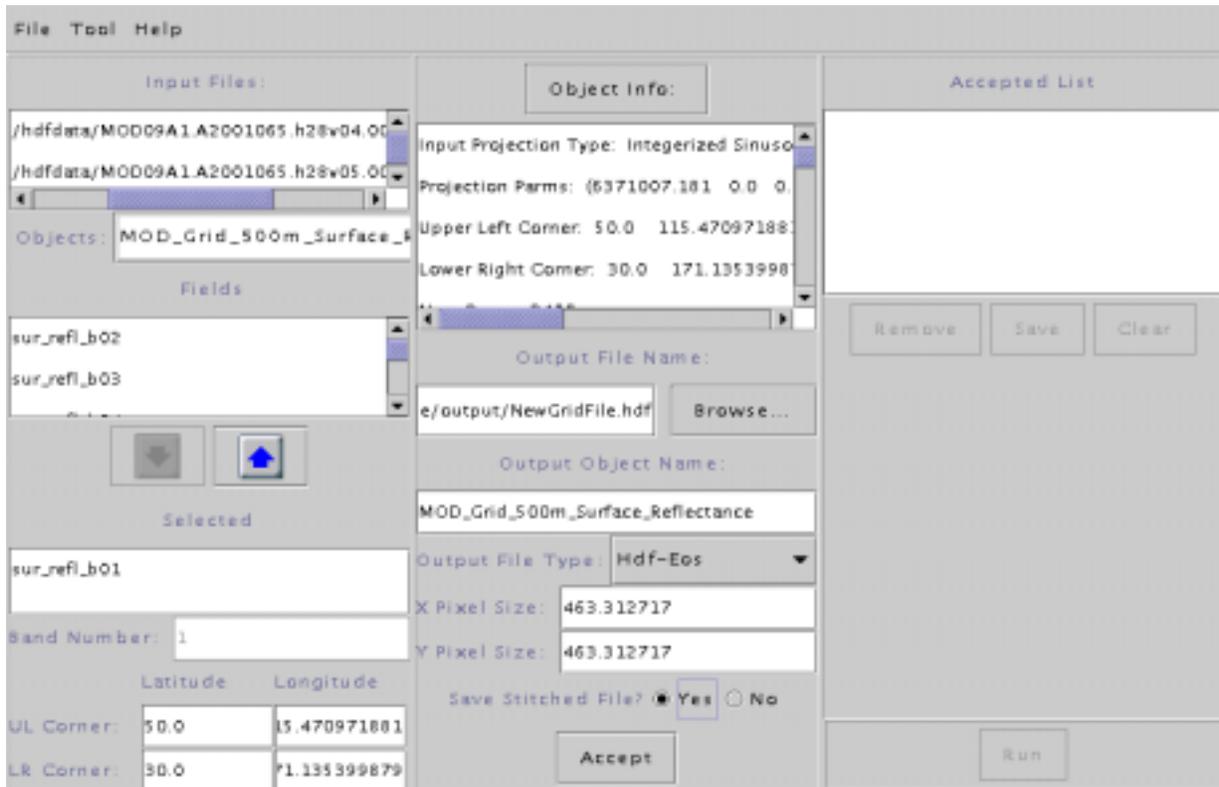


Figure 5.12: Grid Stitch/Subset example

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)

6. Software Architecture

6.1 HDF-EOS to GeoTIFF Converter

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.

header file to HEG GUI

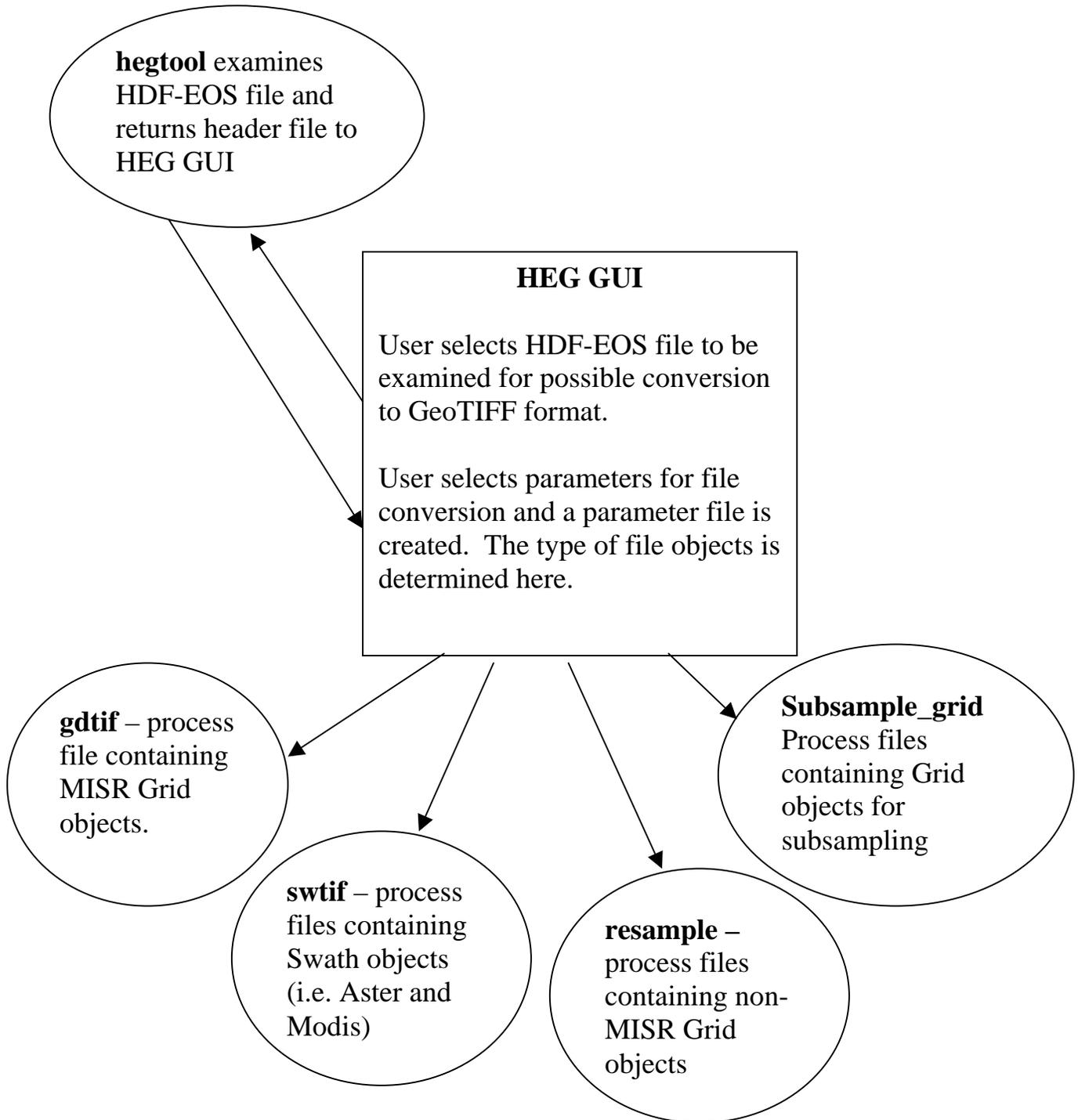


Figure 6.1: Overview of HEG Tool

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.

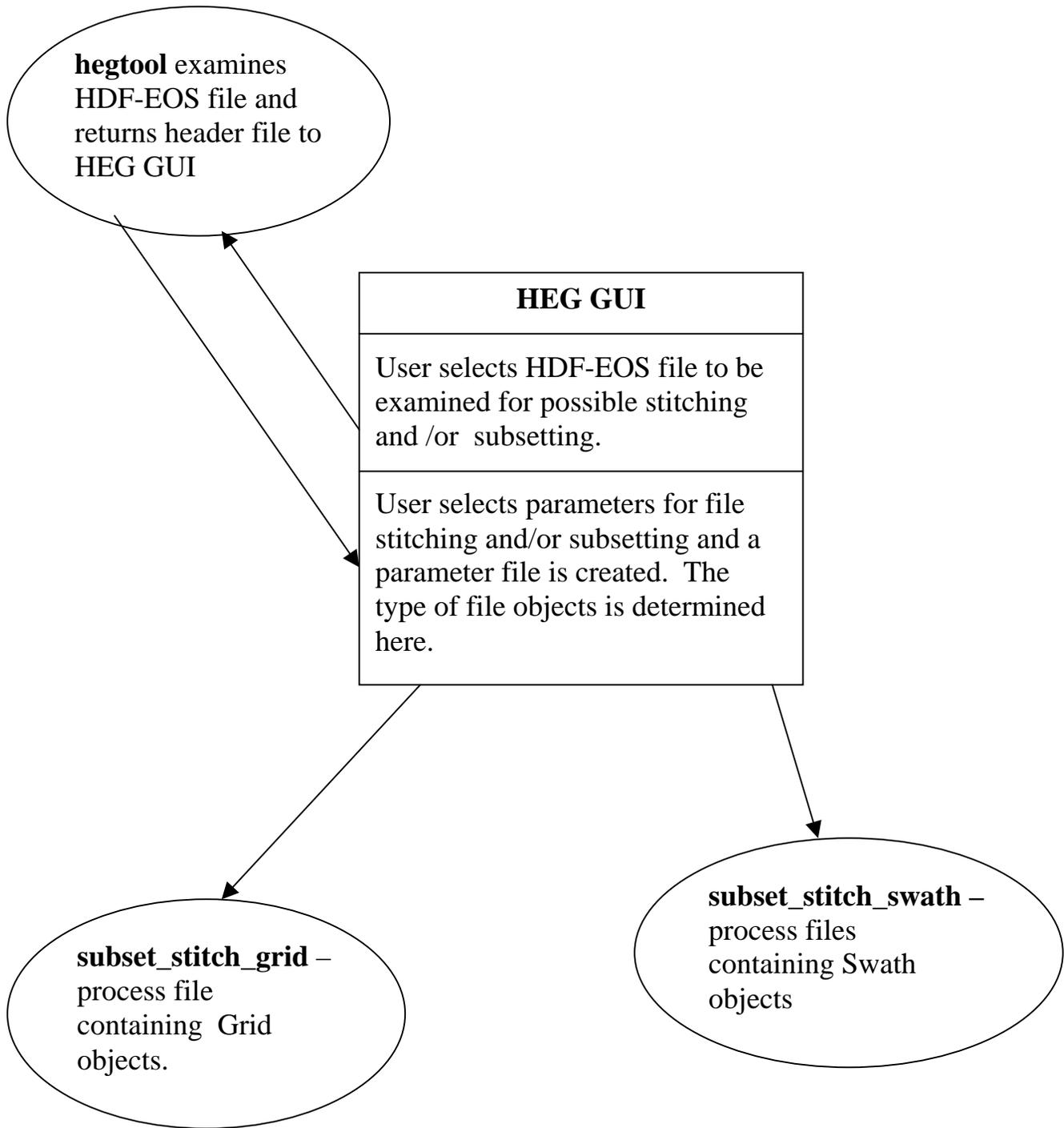


Figure 6.2: Overview of Stich/Subset Function

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.

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.

7.2.2 Format of Header File

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.

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_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 = x 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.

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=/home/hdfdata/MODIS/MOD43B1.A2001065.h27v04.003.2001206182422.hdf

NUM_OBJECTS=1

NUM_GRIDS=1

NUM_SWATHS=0

GRID_NAMES=MOD_Grid_BRDF,

GRID_PROJECTION_TYPE=31

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=50.000000000 140.020167280

GRID_LR_CORNER_LATLON=40.000000000 130.539229758

GRID_NCOLUMNS=1200

GRID_NROWS=1200

GRID_PIXEL_SIZE=926.625433

GRID_PIXEL_SIZE_X=926.625433

GRID_PIXEL_SIZE_Y=926.625433

GRID_NFIELDS=4

GRID_FIELD_NAMES=BRDF_Albedo_Parameters,BRDF_Shape_Indicators,BRDF_Albedo_Quality,BRDF_Type,

GRID_DATA_TYPES=22 21 25 21

GRID_NUM_DIMS=4 3 3 3

GRID_NUM_BANDS=10 8 2 2

GRID_4TH_DIM=3 0 0 0

GRID_BAND_NAME=Num_Land_Bands_Plus3,Num_Shape_Fields,Num_QC_Words,Num_Type_Fields,

GRID_4TH_DIMNAME=Num_Parameters,-99,-99,-99,

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

STATUS_VALUE=0

FILE_NAME=/home/hdf/data/AST_L1BE_002062420010942260000000.hdf

NUM_OBJECTS=3

NUM_GRIDS=0

NUM_SWATHS=3

SWATH_NAMES=VNIR_Swath,\
SWIR_Swath,\
TIR_Swath,

SWATH_NFIELDS=3 \
6 \
5

SWATH_FIELD_NAMES=ImageData1,ImageData2,ImageData3N,\
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

SWATH_NUM_BANDS=1 1 1 \
1 1 1 1 1 \
1 1 1 1 1

SWATH_DIM_X_SIZE=4200 4200 4200 \
2100 2100 2100 2100 2100 \
700 700 700 700 700

```
SWATH_DIM_Y_SIZE=4980 4980 4980 \  
2490 2490 2490 2490 2490 2490 \  
830 830 830 830 830
```

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

```
SWATH_LAT_MIN=-5.127131 -5.127207 -5.127512
```

```
SWATH_LAT_MAX=-4.471522 -4.471599 -4.471904
```

```
SWATH_LON_MIN=12.891827 12.891885 12.892114
```

```
SWATH_LON_MAX=13.639146 13.639203 13.639433
```

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 Reading the Header File

The header is written to conform to Java Properties class standards. Therefore, reading the header file 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), UTM Projection (UTM), Polar Stereographic Projection (PS) or Transvers Mercator (TM). In Version 1.0, 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
```

For proper handling of metadata user must set environment variables “PGSHOME” and “MRTDATADIR” to the “TOOLKIT” and “data” directories in the “heg” directory respectively.

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_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 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-dimensional, 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, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, or TM.

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.

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
)
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
```

In Version 1.0 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_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 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, 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.

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 )
```

```
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 Geographical projection. 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 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 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
```

For proper handling of metadata user must set environment variables “PGSHOME” and “MRTDATADIR” to the “TOOLKIT” and “data” directories in the “heg” directory respectively.

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 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 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.

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. 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.

NUMBER_X_POINTS = number of columns in output grid

NUMBER_Y_POINTS = number of rows in output grid

- These are the number of columns and rows in the Geographical grid that is created from the conversion of whole swath. If the grid is subsetted (see explanation for next two fields), the subsetted grid will have different number of columns and rows from the values entered.

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 TIFFfile name

- The output TIFF file name. 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 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 = /home/hdf/pg-PR1B0000-2001050902_004_001.hdf

OBJECT_NAME = TIR_Swath

FIELD_NAME = ImageData10|

BAND_NUMBER = 1

```
NUMBER_X_POINTS = 830
NUMBER_Y_POINTS = 700
SPATIAL_SUBSET_UL_CORNER = ( -19.321566 23.270499 )
SPATIAL_SUBSET_LR_CORNER = ( -19.98265 24.065843 )
OUTPUT_FILENAME = /home/outdata/OutHDFEOS_TIR_Swath.hdf
OUTPUT_TYPE = HDFEOS
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 Geographical 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 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 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_swath` tool will issue warning for attributes not found in the input HDF 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
```

For proper handling of metadata user must set environment variables "PGSHOME" and "MRTDATADIR" to the "TOOLKIT" and "data" directories in the "heg" directory respectively.

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 PIPE "|".

OUTPUT_FILENAME = output HDF file name

- The output 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 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 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 since the tool uses them to find the number of pixels in the output grid.

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 = /net/htsc/pg_049.hdf/net/htsc/pg_050_001.hdf

OUTPUT_FILENAME = /net/htsc/test/ASTER_output_grid.hdf

OBJECT_NAME = TIR_Swath

FIELD_NAME = ImageData10

OUTPUT_OBJECT_NAME = TIR_Grid

BAND_NUMBER = 5

SPATIAL_SUBSET_UL_CORNER = (48.72 -123.83)

SPATIAL_SUBSET_LR_CORNER = (48.10 -123.27)

OUTGRID_X_PIXELSIZE = 0.006

OUTGRID_Y_PIXELSIZE = 0.007

SAVE_STITCHED_FILE = YES

OUTPUT_STITCHED_FILENAME = /net/htsc/test/ASTER_output_grid_stitched.hdf

```
OUTPUT_TYPE = HDFEOS
END
```

7.7 Grid Subset/Stitch

The `subset_stitch_grid` converter tool is used to read 1 or more similar grids from HDF files, stitch them together and then subset the stitched grid (if requested). The output then is written to an HDF 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 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
```

For proper handling of metadata user must set environment variables "PGSHOME" and "MRTDATADIR" to the "TOOLKIT" and "data" directories in the "heg" directory respectively.

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 PIPE "|".

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.

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 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 HDFEOS and SAVE_STICHED_FILE is YES the HDF 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.

SAVE_STITCHED_FILE = YES or NO

- This field should be YES or NO. If it is YES output stitched file will be saved in HDFEOS 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 = 3

INPUT_FILENAMES = /home/som_b60.hdf/home/som_b59.hdf/home/som_b58.hdf

OUTPUT_FILENAME = /net/htsc/test/output_subset.hdf

OBJECT_NAME = BlueBand

FIELD_NAME = Blue Radiance/RDQI

OUTPUT_OBJECT_NAME = BlueBand

BAND_NUMBER = 1

SPATIAL_SUBSET_UL_CORNER = (37.0 14.0)

SPATIAL_SUBSET_LR_CORNER = (36.0 15.0)

OUTGRID_X_PIXELSIZE = 0.00

OUTGRID_Y_PIXELSIZE = 0.00

SAVE_STITCHED_FILE = YES

OUTPUT_STITCHED_FILENAME = /net/htsc/test/output_stiched.hdf

OUTPUT_TYPE = BIN

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:

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

For proper handling of metadata user must set environment variables "PGSHOME" and "MRTDATADIR" to the "TOOLKIT" and "data" directories in the "heg" directory respectively.

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 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 PIPE “|”.

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.

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 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.

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, POLAR_STEREOGRAPHIC, PS, UNIVERSAL_TRANSVERSE_MERCATOR, UTM, or TM. 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_AF_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 = ECSDataGranule
  OBJECT = SizeMBECSDataGranule
    Data_Location = "DSS"
    TYPE = "DOUBLE"
    NUM_VAL = 1
    Mandatory = "FALSE"
  END_OBJECT = SizeMBECSDataGranule
  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 = ECSDataGranule
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

Appendix A. Initial List of Products Tested

MISR Products:

L1B2 Ellipsoid Data
L1B2 Terrain Data
L2 Land Products
L2 Aerosol Products
L2 Cloud Products

ASTER Products:

ASTER Level 1B Registered Radiance at Sensor
ASTER Level 2 Brightness Temperature at the Sensor
ASTER Level 2 Emissivity Product
ASTER Level 2 Decorrelation Stretch Product (VNIR)
ASTER Level 2 Decorrelation Stretch Product (SWIR)
ASTER Level 2 Decorrelation Stretch Product (TIR)
ASTER Level 2 Surface Reflectance Product (VNIR)
ASTER Level 2 Surface Reflectance Product (SWIR)
ASTER Level 2 Surface Reflectance Product (TIR)
ASTER Level 2 Surface Kinetic Temperature Product
ASTER Level 2 Surface Radiance Product (VNIR)
ASTER Level 2 Surface Radiance Product (SWIR)
ASTER Level 2 Surface Radiance Product (TIR)
ASTER Level 3 DEM Product

MODIS Products:

Level 1

MOD021KM = Level 1B Calibrated Radiances (1000 m)
MOD02HKM = Level 1B Calibrated Radiances (500 m)
MOD02QKM = Level 1B Calibrated Radiances (250 m)
MOD03 = Level 1A Geolocation Fields – 5-Min Swath (1km)

Level 2

MOD09GQK = Level 2 Land Surface Reflectance - 250 m,
MOD09GHK = Level 2 Land Surface Reflectance - 500 m
MOD09GST = Level 2 Land Surface Reflectance - 1 km
MOD10_L2 = Level 2 Snow Cover- 500 m
MOD11_L2 = Level 2 Land Surface Temperature and Emissivity - 1 km

Level 3

MOD09A1 = Level 3 8-Day Gridded Surface Reflectances - 500 m
MOD09Q1 = Level 3 8-Day Gridded Surface Reflectances - 250 m
MOD10A1 = Level 3 Daily Gridded Snow Cover Product - 500 m
MOD11A1 = Level 3 Gridded Daily Land Surface Temperature/Emissivity - 1 km

MOD12Q1 = Level 3 Gridded 96-Day Land Cover – 1km
MOD14A1 = Level 3 Daily Gridded Thermal Anomalies - 1 km
MOD14A2 = Level 3 8-day Gridded Thermal Anomalies - 1 km
MOD15A2 - Leaf Area Index/FPAR 8-Day L4 Global 1km ISIN Grid
MOD17A2 - Net Photosynthesis 8-Day L4 Global 1km ISIN Grid
MOD29P1D = L3 Daily Gridded Sea Ice Extent - 1 km for Day Mode
MOD29P1N = L3 Daily Gridded Sea Ice Extent - 1 km for Night Mode
MOD43B1 = Level 3 16-day SemiEmpirical BRDF and Albedo Product - 1 km (3-D only)
MOD43B3 = Level 3 16-day Minimal BRDF and Albedo Product - 1 km (3-D only)
MOD43B4 = Level 3 16-day BRDF Adjusted Nadir Surface Reflectance - 1 km (3-D only)

Digital Elevation Model:

1 Km Global DTED