THEMIS
Science Data Analysis
Software User's Guide

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TBD List

Identifier	Description

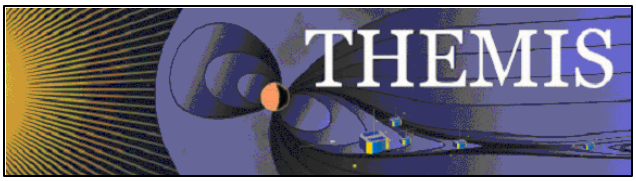


Table of Contents

DOCUMENT REVISION RECORD....2
DISTRIBUTION LIST....2
TBD LIST....2
1. INTRODUCTION....6
1.1 Purpose and Scope....6
1.2 Applicable Documents....6
2. THEMIS WEB DATA AND SOFTWARE INTERFACE....7
2.1 THEMIS Web Site - Home Page....7
2.2 THEMIS Data Web Pages....9
2.3 THEMIS Software Web Page....13
2.4 THEMIS Software - For Developers Web Page....19
2.5 THEMIS Contact Us Web Page....21
3. THEMIS SCIENCE SUPPORT HELP SYSTEM....22
3.1 Themis Science Support HELP Process....22
3.2 THEMIS Science Support HELP Form....23
3.3 THEMIS Science Support HELP Form - GUI Text Form....24
3.4 HELP Form Location - GUI Message Window....25
3.5 Saved History Location - GUI Message Window....25
4. THEMIS DATA....26
4.1 THEMIS DATA Overview....26
4.2 THEMIS DATA Quantity Summary....26
5. THEMIS DATA ANALYSIS SOFTWARE....29
5.1 System Requirements....29
5.2 Known Limitations....29
5.3 Installation and Configuration....29
5.3.1 IDL PATH setup....30
5.3.1.1 IDL PATH Setup on Windows (and IDLDE on UNIX, Linux and Mac)....30
5.3.1.2 IDL PATH Setup for IDL Command Line (UNIX, Linux or Mac OS X)....30
5.3.2 Data Directory Setup....30

5.4 How to Get Started....31
5.5 Software Functions....33
5.5.1 Loading THEMIS Data....33
5.5.2 General Conventions: variable name construction and reference....33
5.5.3 Plotting the data....34
5.5.4 Calibrations and Beyond....35
5.5.5 Coordinate Transformations....35
5.5.6 Data Export....36
5.5.7 Managing Your Data Cache....36
5.5.8 Configuring Local Data Cache and Remote Access Behavior....37
5.5.8.1 Configuration at startup....37
5.5.8.2 On-the-Fly configuration....37
5.6 Software Organization....38
6. GRAPHICAL USER INTERFACE (GUI) 39
6.1 Main Window....39
6.1.1 Loaded Data Window....40
6.1.2 Choosing Data Using Strings....40
6.1.3 Active Data Window....40
6.1.4 History Window....41
6.1.5 Progress Window....41
6.1.6 Data Choices Selection Buttons....41
6.1.7 Time Range Selection Buttons....43
6.1.8 Load Data Button....45
6.1.9 Clear Load Queue Button....45
6.1.10 Help Button....46
6.1.11 Error Button....47
6.1.12 Config Button....48
6.1.12.1 Reset....49
6.1.12.2 Reset to default....49
6.1.12.3 Save....49
6.1.12.4 Message Window....49
6.1.12.5 Exit button....49
6.2 Coordinate Transformation Widget....50
6.3 Data Processing Widget....51
6.3.1 Message Window....51
6.3.2 Subtract Average....52
6.3.3 Subtract Median....52
6.3.4 Smooth Data....52
6.3.5 Time Average....52
6.3.6 Clip....53
6.3.7 Deflag....53
6.3.8 Degap....53
6.3.9 Clean Spikes....54
6.3.10 Time Derivative....54

6.3.11 Wavelet Transform....54
6.3.12 Dpwrspec....54
6.3.13 Time Limits....54
6.3.14 Rename....55
6.3.15 Save....55
6.3.16 Restore....56
6.3.17 Save Ascii....56
6.3.18 Delete....56
6.3.19 Close....56

6.4 Plot Data (Main GUI Widget)....57

6.4.1 Set Time Limits....57
6.4.2 Ylimt....58
6.4.3 Zlimit....58
6.4.4 Spectrogram....58
6.4.5 Plot Window Size....59
6.4.6 Plot Window Number....59
6.4.7 Create New Window....59
6.4.8 Plot Type....59
6.4.9 Draw Plot....60
6.4.10 Close....60
6.4.11 Message Window....60

6.6 Overview Plot Widget....61

6.7 GUI Tips....62

1. Introduction

1.1 Purpose and Scope.

The purpose of this document is to present to the worldwide scientific community what tools are available for viewing, downloading, processing, calibrating and plotting THEMIS data and how to use these tools.

1.2 Applicable Documents.

1.	THM_SYS_012_PDMP	THEMIS Project Data Management Plan
2.	THM_SOC_101_TIME	THEMIS TIME Definition
3.	THM_SOC_103_HKP_VARNAMES	THEMIS Housekeeping L1 Variable Name Def's
4.	THM_SOC_105_FIELDS_VARNAMES	THEMIS Fields Variable Names Definitions
5.	THM_SOC_108_GMAG_L1_VARNAMES	THEMIS GMAG Variable Name Definitions
6.	THM_SOC_110_COORDINATES	THEMIS Coordinate Systems Definitions
7.	THM_SOC_111_SUNSENSPROC	THEMIS SUN SENSOR Science Processing
8.	THM_SOC_112_ATTPAIPROC	THEMIS Science ATT & Inertia Determ.
9.	THM_SOC_113_FGM_CALPROC	THEMIS FGM CAL File and Processing
10.	THM_SOC_114_SCM_CALPROC	THEMIS SCM CAL File and Processing
11.	THM_SOC_115_EFI_CALPROC	THEMIS EFI CAL File and Processing
12.	THM_SOC_116_ESA_CALPROC	THEMIS ESA CAL File and Processing
13.	THM_SOC_117_SST_CALPROC	THEMIS SST CAL File and Processing
14.	SAI-SPEC_1079A (Oct. 26, 2005)	THEMIS Coordinate Systems
15.	SAI-RPR-0722a (September, 2006)	Probe Alignment Report (MSSS data, p18)
16.	pturin e-mail on Faro alignment results (9/28/06)	FGM, SCM mag alignments
17.	THM-MB-005-Magnetometer clocking r7.pdf	MAG clocking angles

2. THEMIS Web Page Interface

2.1 THEMIS Web Site - Home Page

The THEMIS Home Web Page can be displayed by using the following URL: http://themis.ssl.berkeley.edu/. Across the top portion of this web page are a series of drop down menus (Home, The Mission, Data, Software, Publications, News & Events, Contact Us and For the Public). In this document we will be discussing only the Data, Software and Contact Us Web Pages.

The THEMIS Data Drop Down Menu allows you to select the following options: *Summary Plots*, *Orbits* or to *Download Data*. These options will be discussed in more detail in Section 2.2.

The THEMIS Software Drop Down Menu allows you to Select the following options: *Software*, *Developers* and *Documentation*. These options will be discussed in more detail in Section 2.3.

The THEMIS Contact Us will automatically link you to a web page that will allow you to send emails to the THEMIS PI or THEMIS Instrument Scientists or send a Help Request to the THEMIS Science Support Team with Comments, Observations, Problems or Questions concerning data, a document, download, GUI, Plot, Software, Web Interface or any other issue not listed.
This Help Request option will be discussed in more detail in Section 2.4.

Please note: Differences between the screen displays presented in this document and what you may see online are due to Web Page Upgrades not yet reflected in this document. The screen displays incorporated into this document are to give the reader a sense of the functionality of the of the Web Interface to THEMIS Science Software.

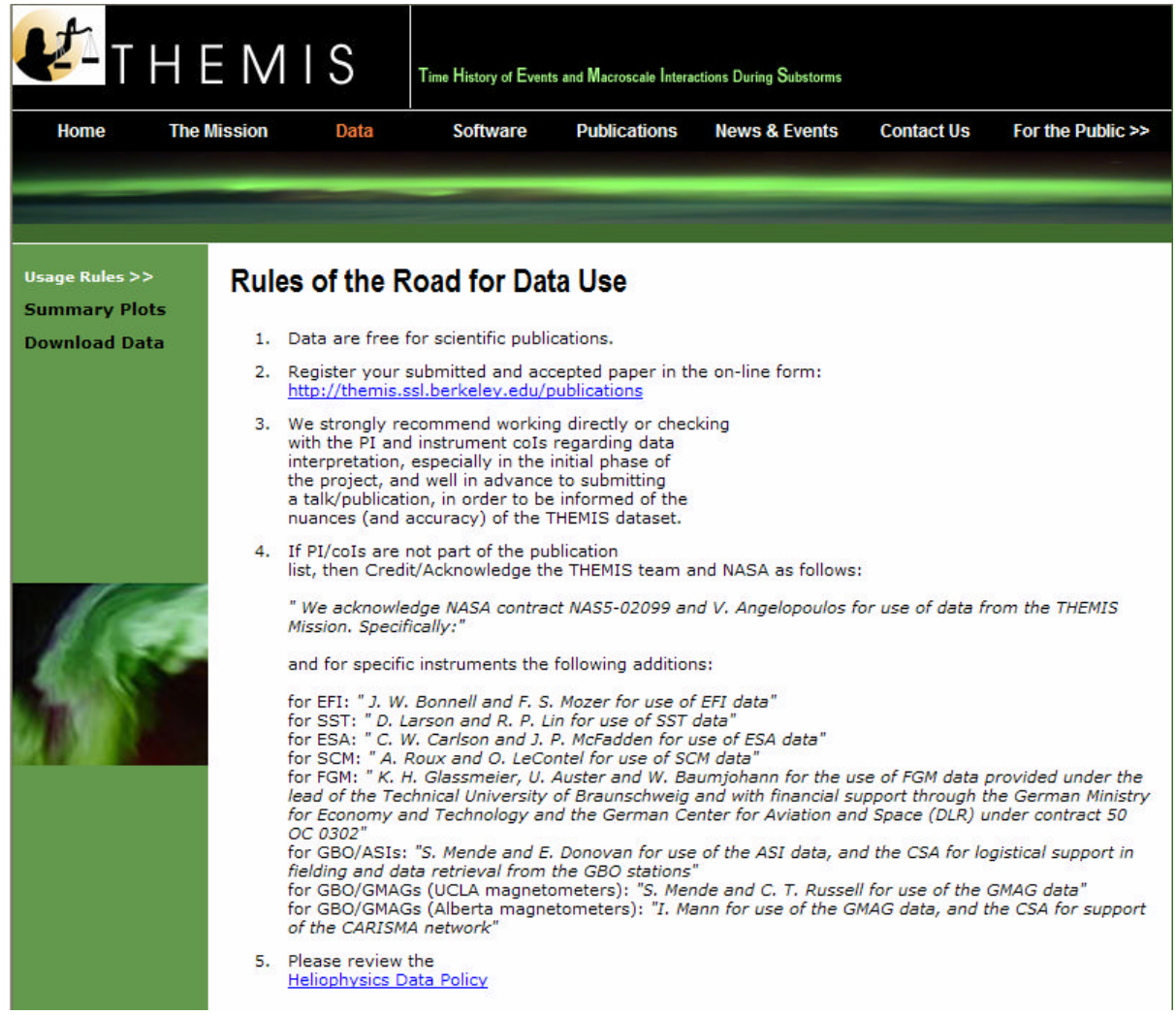
Please see copy of the Themis Home Web Page on the Next Page.

THEMIS Web Site - Home Page

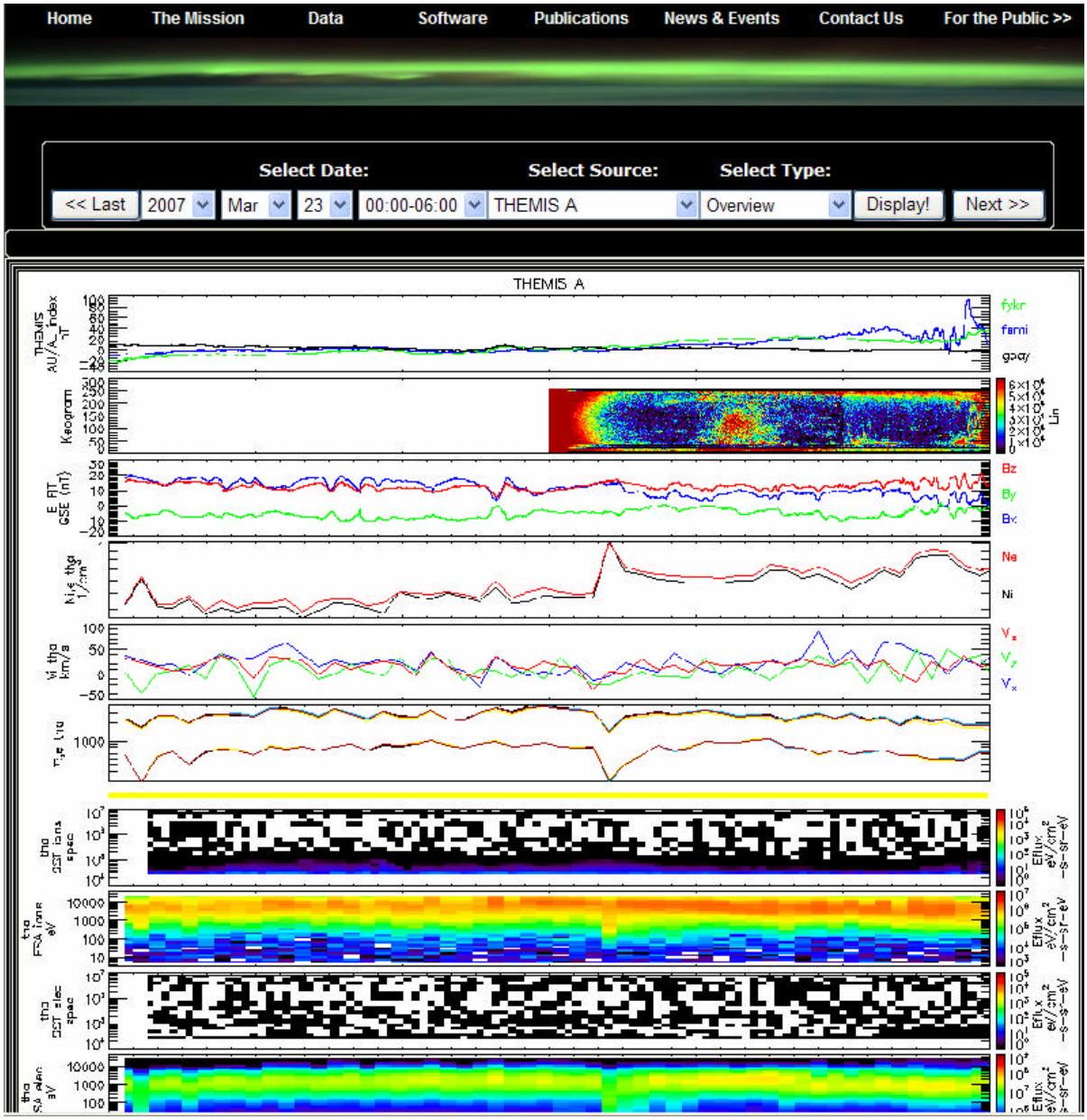
2.2 THEMIS Data Web Pages

The THEMIS Data Drop Down Menu has three Options. *Usage Rules* which will display the Rules for using the THEMIS Data (Rules of the Road*). Summary Plots* which will allow you to look at Summary Plots of one Probe, Multiple Probes, Ground Magnetometer, All Sky Imager or Orbits Data. *Download Data* to Download THEMIS Data. **Please note**: If using THEMIS Science Software Data Analysis Tools there is no need to use the Download Data option. Please see screen displays below.

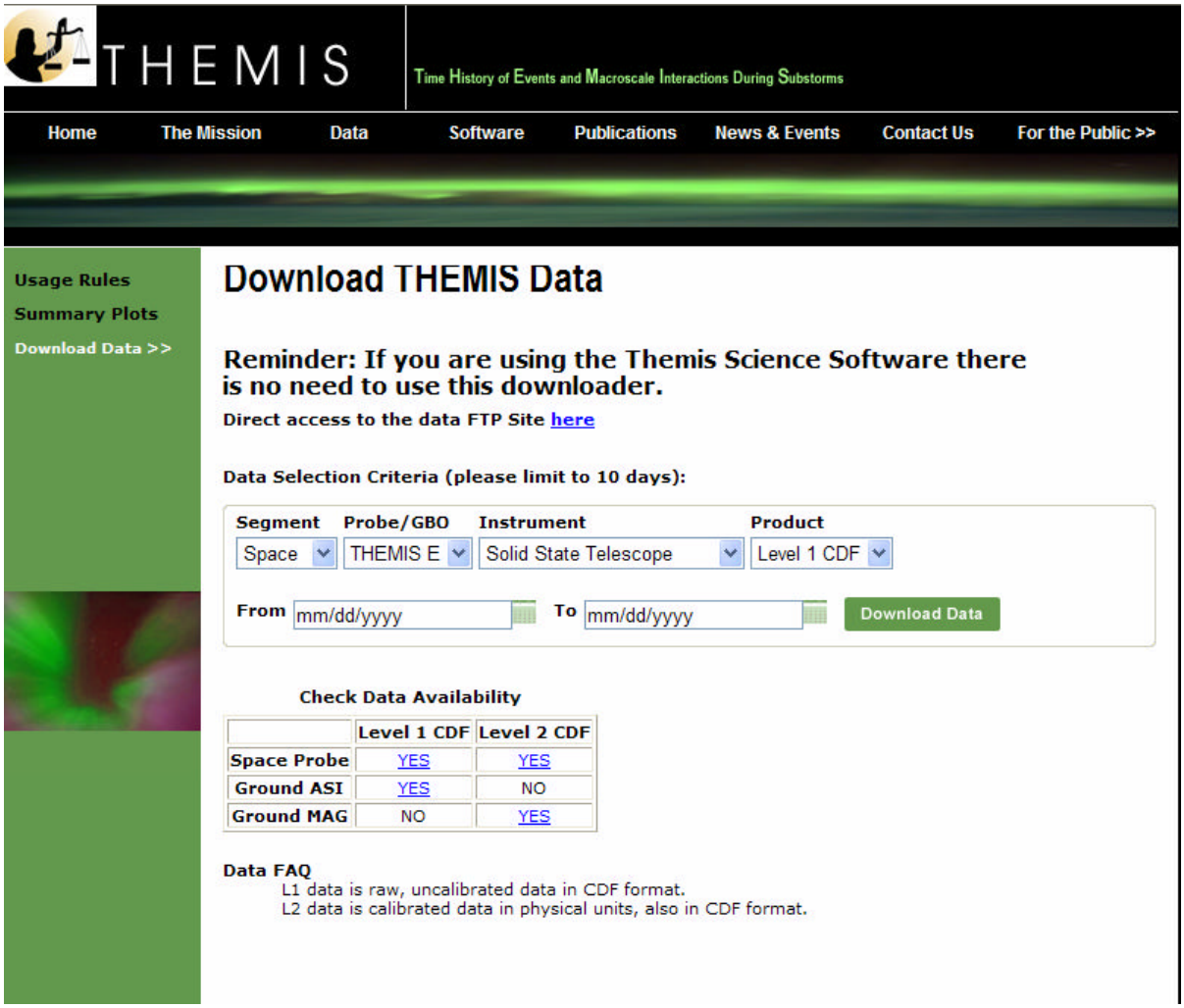
THEMIS Data Dropdown Menu



THEMIS Data Usage Rules Web Page



THEMIS Data Summary Plot Web Page

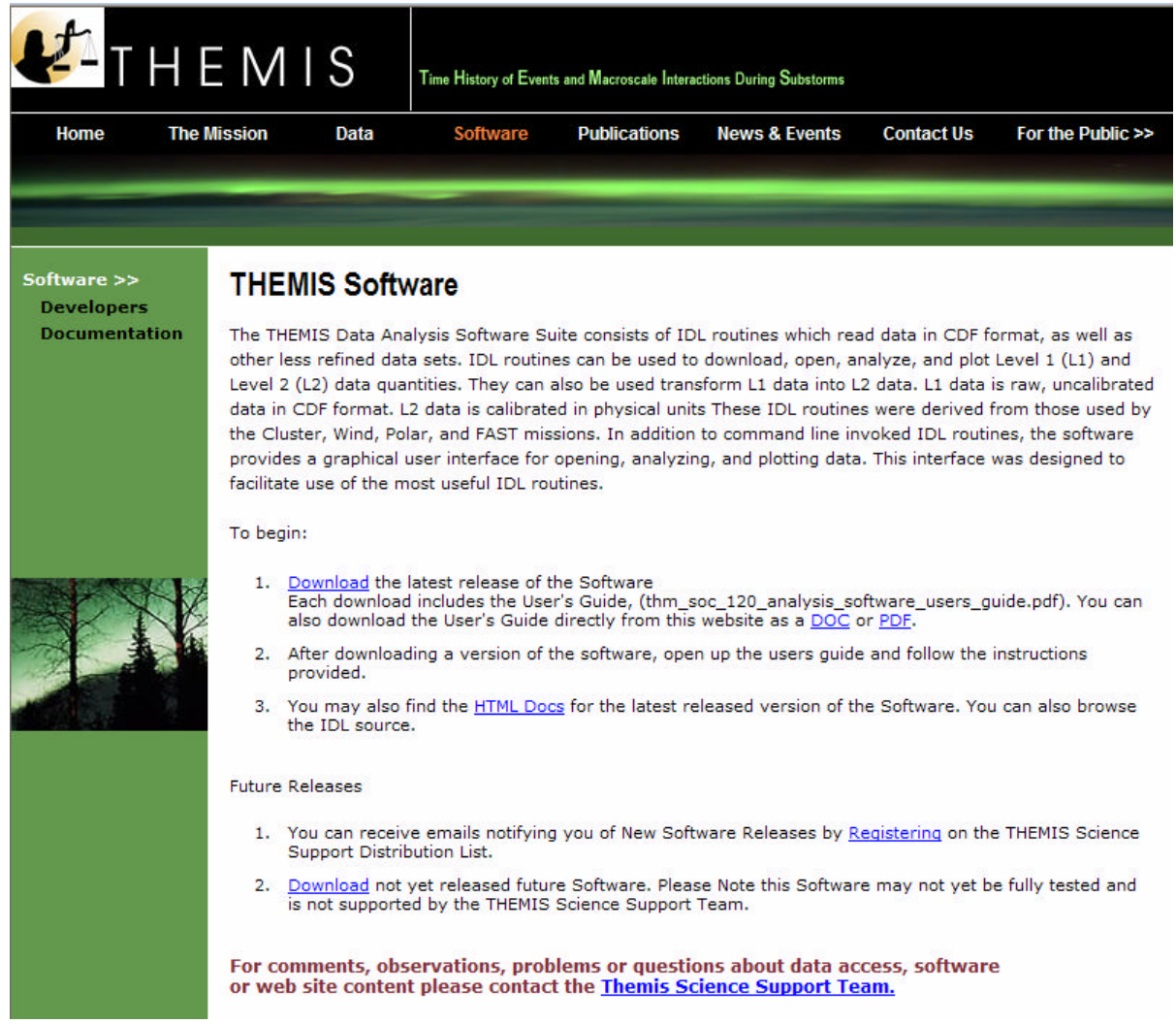


THEMIS Download Data Web Page

2.3 THEMIS Science Software Web Page

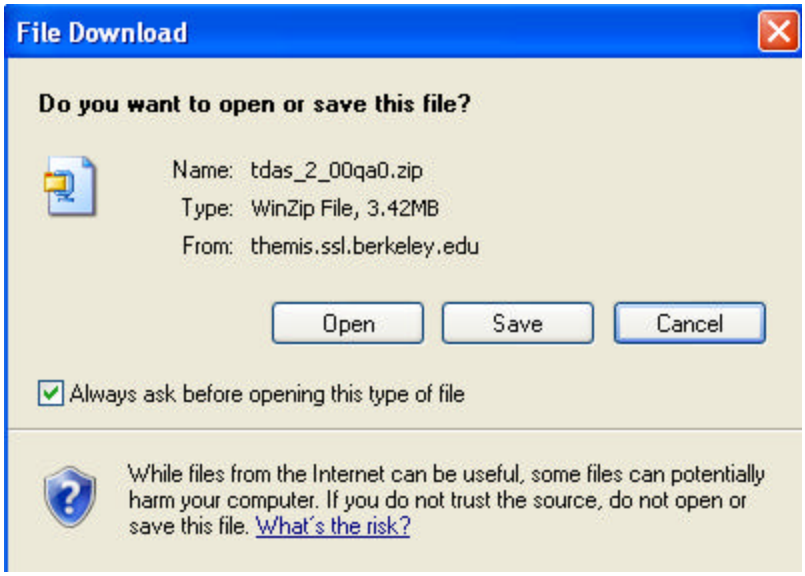
The THEMIS Science Software Drop Down Menu has three options. *Software* which displays a web page for downloading the latest release of the THEMIS Science Software Data Analysis Tools, Documentation, Registering to be notified of Future Releases of the Software, Download not yet released Software and Contacting the THEMIS Science Support Team with Help Requests. *Developers*, options to read about how to develop and contribute Software to THEMIS Science Software. *Documentation* which provides a link to the THEMIS Science Software Documentation ftp site. **Please note:** If you download the not yet released Software, this Software may not have been tested (you are on your own). Please see screen displays below.

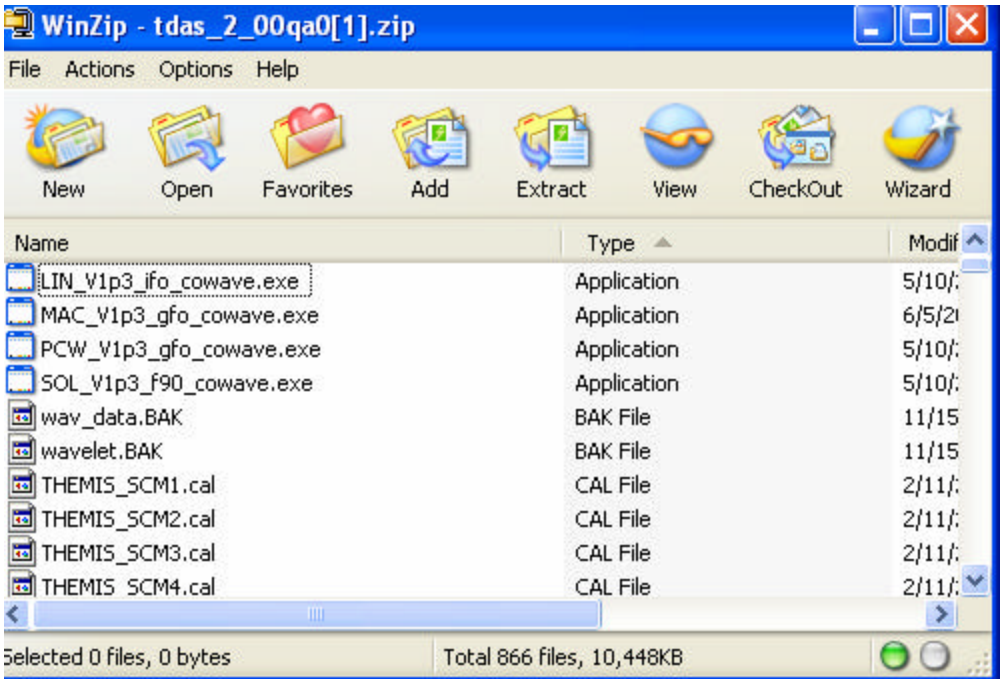
THEMIS Science Software Drop Down Menu



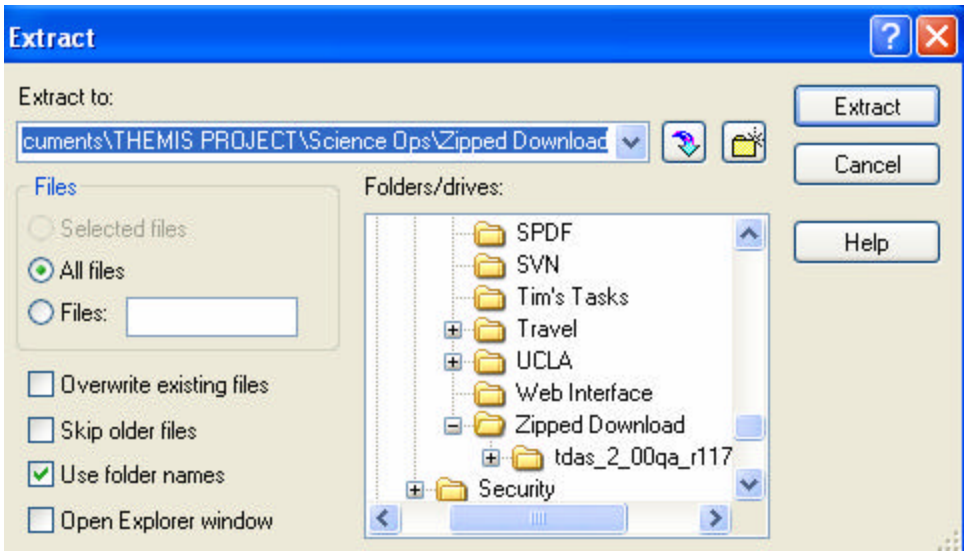
THEMIS Science Software Web Page

When you click on Download the latest release on a Windows machine A File Download dialogue box will be displayed. Click on 'Open' and the WinZip box will appear. Select the Extract icon to download the unzipped versions of the THEMIS Science Software to your computer. Notice the Extract display will ask you where to put the downloaded files. Please see Screen displays on th this and the next page.

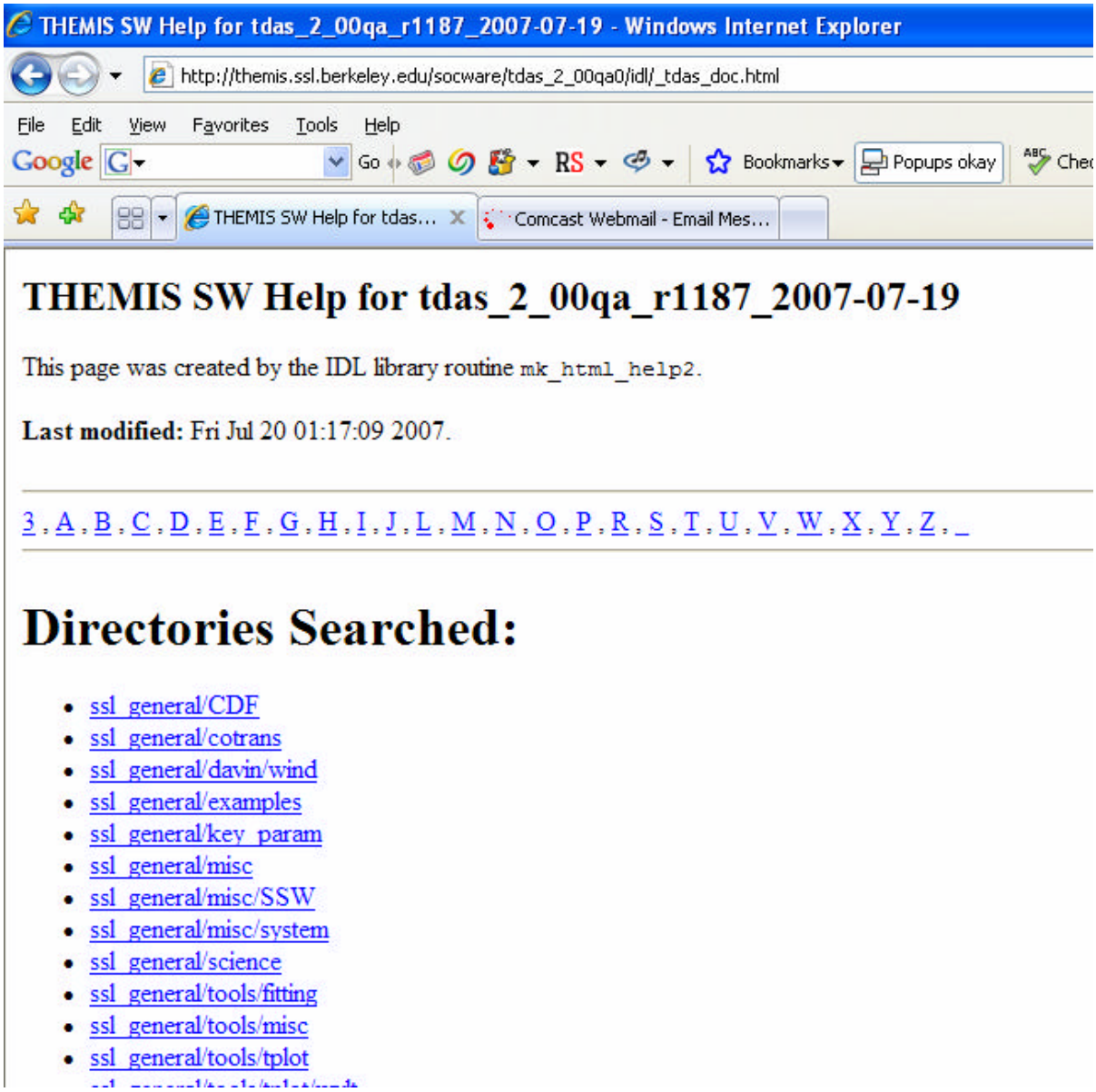




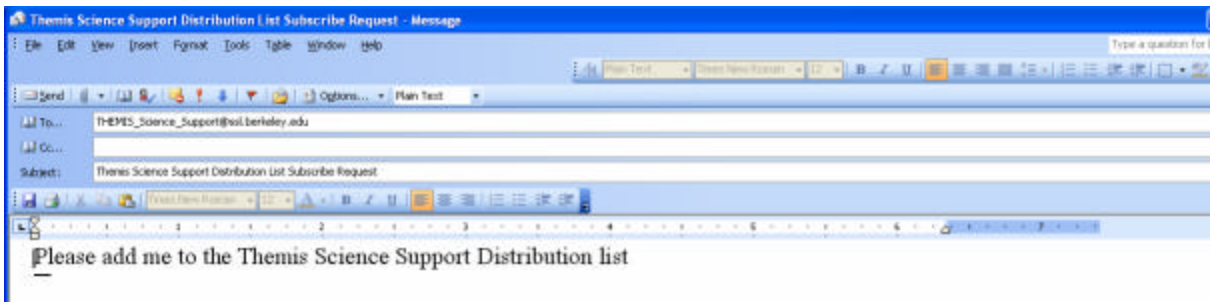
THEMIS Science Software - Download Software



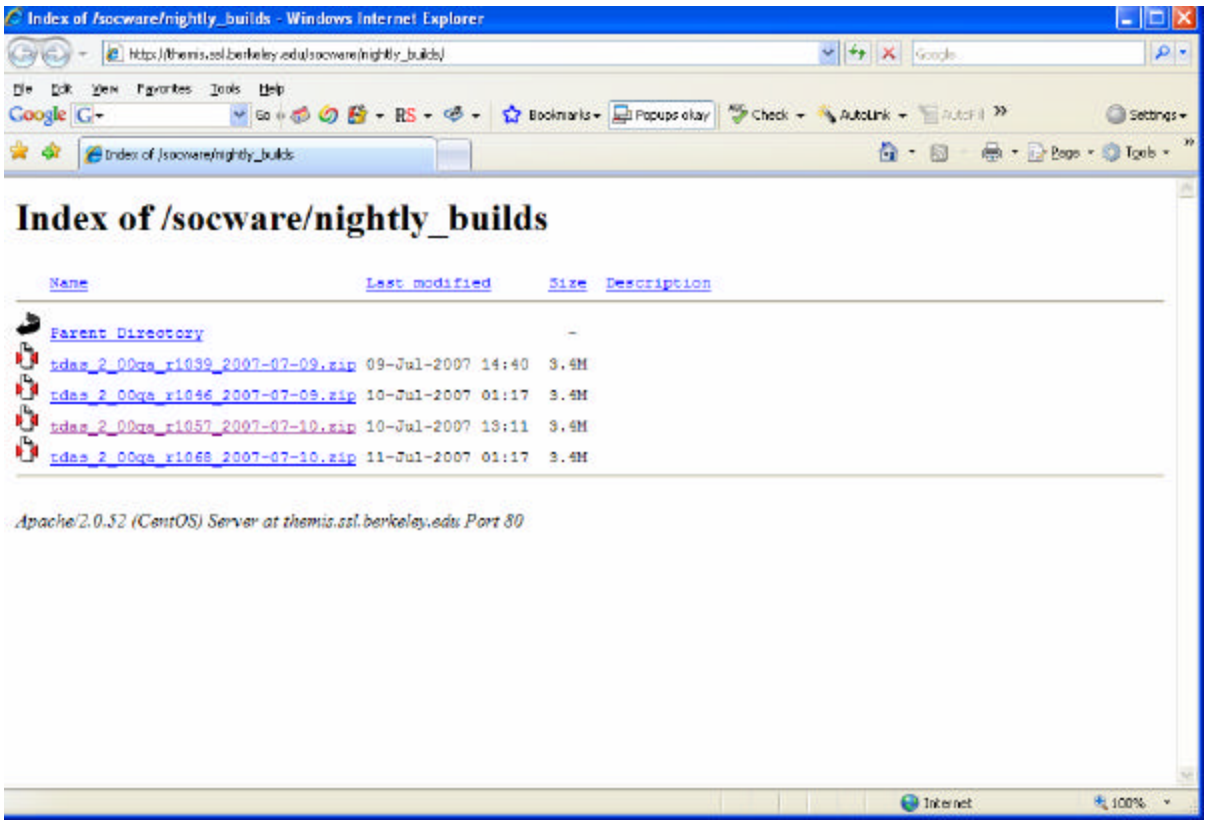
THEMIS Science Software - Download Software



THEMIS Science Software - HTML Docs



THEMIS Science Software - Registration for Notification

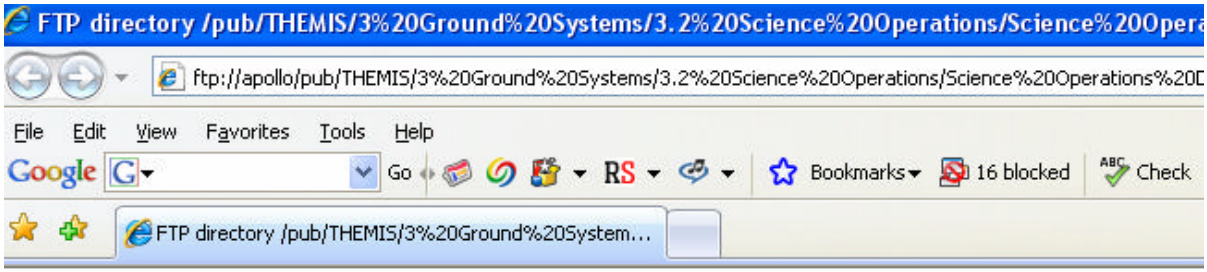


THEMIS Science Software - Download Not Yet Released Software

2.4 THEMIS Science Software - For Developers Web Page

The THEMIS Science Software for Developers Web Page has links to aide software developers how to develop and contribute software to the THEMIS Science Software library. The 'Additional Documentation' option will link you to the ftp site where current THEMIS Science Software documentation can be found.

THEMIS Software - For Developers Web Page



FTP directory /pub/THEMIS/3%20Ground%20Systems/3.2%20Documents/ at apollo

To view this FTP site in Windows Explorer, click **Page**, and then click **Open FTP Site in Windows Expl**

```
You are user #1 of 50 simultaneous users allowed.
```

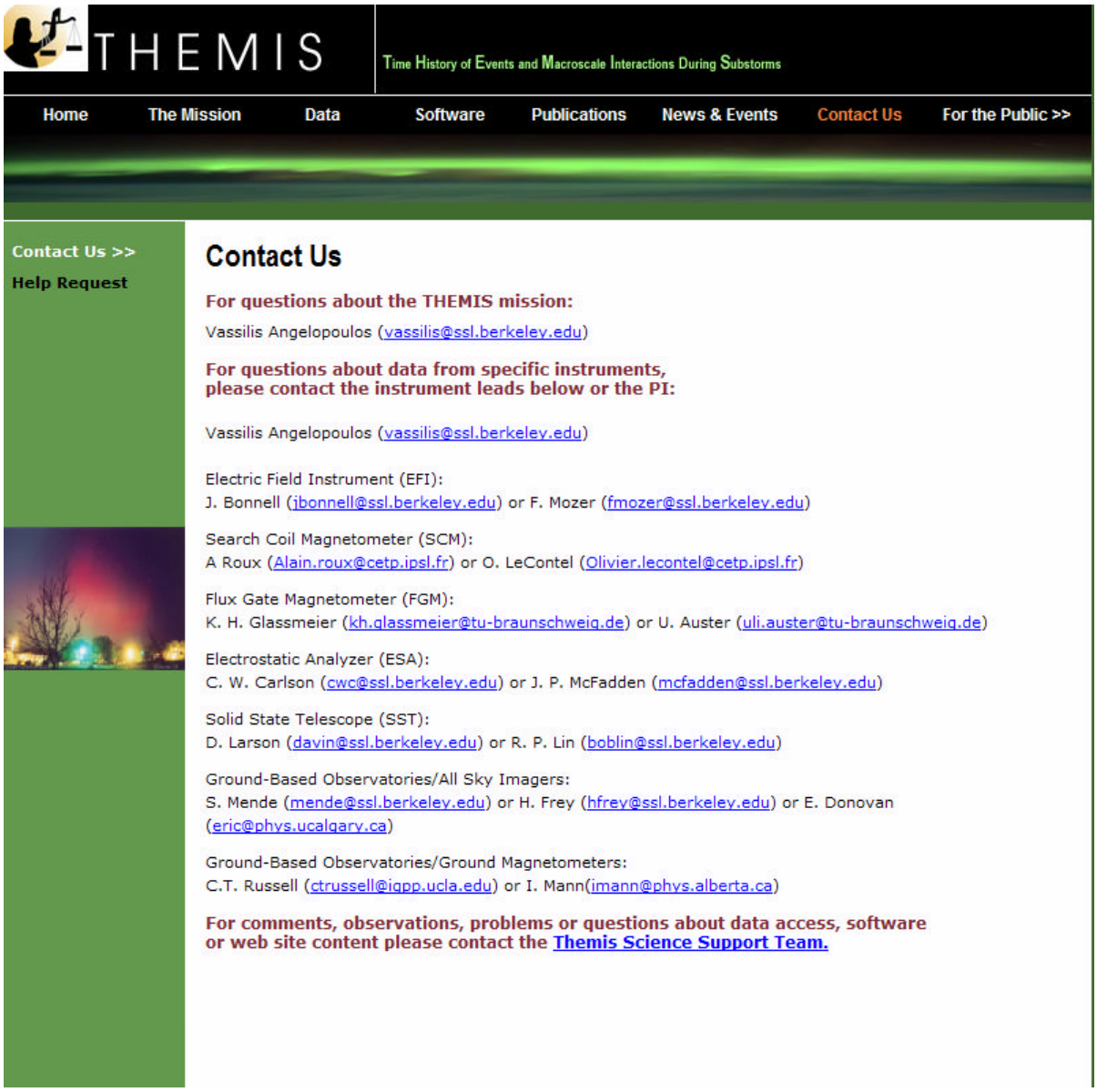
Up to higher level directory

```
05/24/2007 02:41PM       Directory Software Developers Guide
07/11/2007 02:14PM       Directory Software Users Guides
06/15/2007 11:24AM       Directory SpinFits Documents
04/24/2007 08:47AM           147,968 thm_ogs_431m_ephemeris_format_definition.doc
06/15/2007 11:08AM           208,126 thm_ogs_431m_ephemeris_format_definition.pdf
06/15/2007 11:14AM           130,560 thm_soc_101_TIME_20070120.doc
06/15/2007 11:14AM           231,206 thm_soc_101_TIME_20070120.pdf
06/15/2007 11:16AM           130,048 thm_soc_102_STATEFILE_20070420.doc
06/15/2007 11:16AM           231,011 thm_soc_102_STATEFILE_20070420.pdf
06/15/2007 11:16AM           231,936 thm_soc_103_HSK_VARNAMES_20070129.doc
06/15/2007 11:16AM           358,669 thm_soc_103_HSK_VARNAMES_20070129.pdf
06/15/2007 11:16AM           176,128 thm_soc_105_FIELDS_VARNAMES_20060929.doc
06/15/2007 11:16AM           202,932 thm_soc_105_FIELDS_VARNAMES_20060929.pdf
06/15/2007 11:17AM           117,760 thm_soc_106_PARTICLES_VARNAMES_20061102.doc
06/15/2007 11:17AM           151,715 thm_soc_106_PARTICLES_VARNAMES_20061102.pdf
06/15/2007 11:17AM           547,328 thm_soc_108_GMAG_L2_VARNAMES_20060929.doc
06/15/2007 11:17AM           498,732 thm_soc_108_GMAG_L2_VARNAMES_20060929.pdf
06/15/2007 11:17AM           224,256 thm_soc_109_ASI_L1_VARNAMES_20070108.doc
06/15/2007 11:17AM           281,333 thm_soc_109_ASI_L1_VARNAMES_20070108.pdf
06/15/2007 11:18AM           557,568 thm_soc_110_COORDINATES_20060929.doc
06/15/2007 11:18AM           689,082 thm_soc_110_COORDINATES_20060929.pdf
06/15/2007 11:18AM         1,062,400 thm_soc_113_FGM_CALPROC_20061018.doc
06/15/2007 11:18AM           466,223 thm_soc_113_FGM_CALPROC_20061018.pdf
06/15/2007 11:18AM           130,048 thm_soc_119_ASI_CALPROC_20061108.doc
06/15/2007 11:18AM           201,262 thm_soc_119_ASI_CALPROC_20061108.pdf
06/15/2007 11:19AM         2,983,424 thm_sys_012_PDMP_draft_18Oct04.doc
06/15/2007 11:19AM         7,477,970 thm_sys_012_PDMP_draft_18Oct04.pdf
```

THEMIS Software For Developers Web Page - Additional Documentation

2.5 THEMIS Contact Us Web Page

The THEMIS Contact Us Web Page lists the contact information for the THEMIS Principal Investigator as well as the Co-Investigators for each THEMIS Instrument. In addition there is an option to send a Help Request to the THEMIS Science Support Coordinator with comments, observations, problems or questions. The Help Request form and process will be explained in more detail in Section 3. Please see the screen display below.



THEMIS Software Contact Us Web Page

3 THEMIS Science Support Help System

3.1 THEMIS Science Support Help Process

The THEMIS Science Support Help Process for users who have Comments, Observations, Problems or Questions concerning data, a document, download, GUI, Plot, Software, Web Interface or any other issue not listed. The Help Process is a bit different for Step 1 if you are using the Web or the GUI Interface.

For the Web to Help Request Form Interface:
Step 1: From either the Software or Contact Us Web Pages (example on previous page) the user will see the following:
For comments, observations, problems or questions about data access, software or web site content please contact the THEMIS Science Support Team.

If you click on **THEMIS Science Support Team** a Themis Science Support Help Request Form (example in Section 3.2) will be displayed. The user fills out the form and hits 'Submit'. Depending on your computer and email application the processing will be different for the email to be sent. Some computers that is all you need to do and the form is sent automatically.
If you have a PC running Windows a box will be display asking you which email Application you use.
If you use a desktop email application like Outlook, Outlook Express, select that button, hit OK and the Form will be automatically sent to the Support Coordinator. If you choose either of the two other options (Internet Email or Other) Windows will guide you through a three step process to send your email.
Again, if not using windows (e.g. Mac, Linux or Unix) the process maybe different. Yet the main goal is for the Help Request Form to be sent to THEMIS_Science_Support@ssl.berkeley.edu.

For the GUI to the Help Request Form Interface:
Step 1: By clicking on the 'ERROR" box on the GUI Main widget or if the THEMIS Science Software detects and error, a text version of the Help Request Form will be displayed (example in Section 3.3). Fill out the form and then click on 'Save'. In the message window of the GUI Main Widget will be where the GUI has saved your form (example in Section 3.4). It is also good practice to also save your history file by clicking on 'Save History' on the GUI Main widget. As was with the Help Request Form the in the GUI Main widget's message window will be displayed where the system has put your saved History file example in Section 3.5). At this point you can address your email to **THEMIS Science Support Team,** attach your Help Request Form and your History file and send.

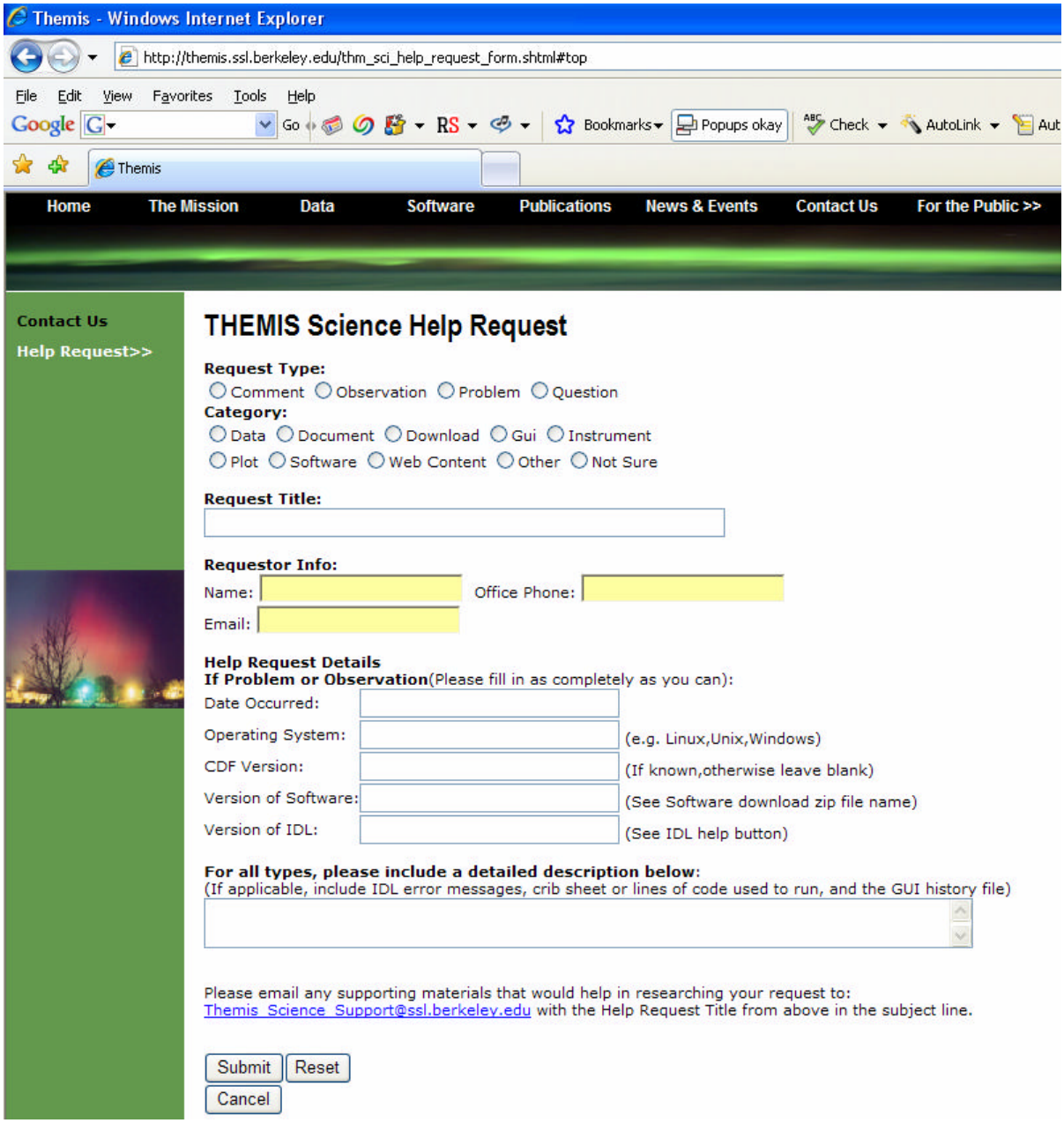
The remaining steps are the same for either the Web or GUI Interface.
Step 2: User sends any additional information (logs, error messages, etc) to THEMIS_Science_Support@ssl.berkeley.edu.

Step 3: The Support Coordinator will log in your help request, send you back an email confirming receipt of your help request with your Help Request Number. The Support Coordinator will also forward your Help Request and any attachments to the person (Actionee) who will investigate and answer your Help Request.

Step 4: The Actionee will contact the User to respond to the comment, observation, problem or question.

Step 5: Feel free at any time to send an email to the Support Coordinator requesting status of your request.

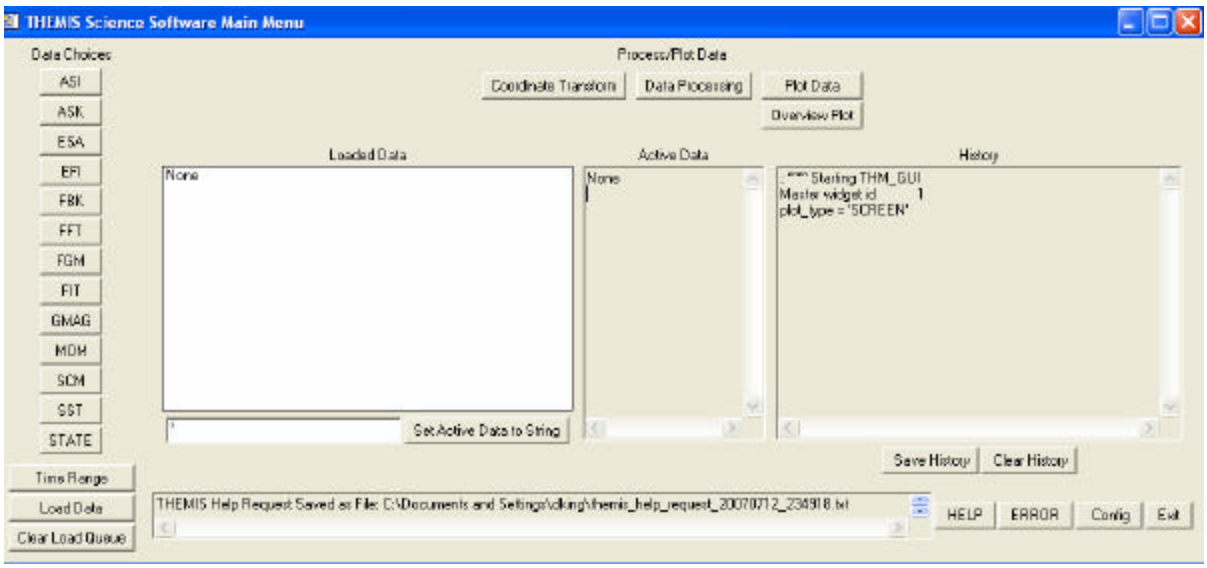
3.2 THEMIS Science Support Help Form - Web Form



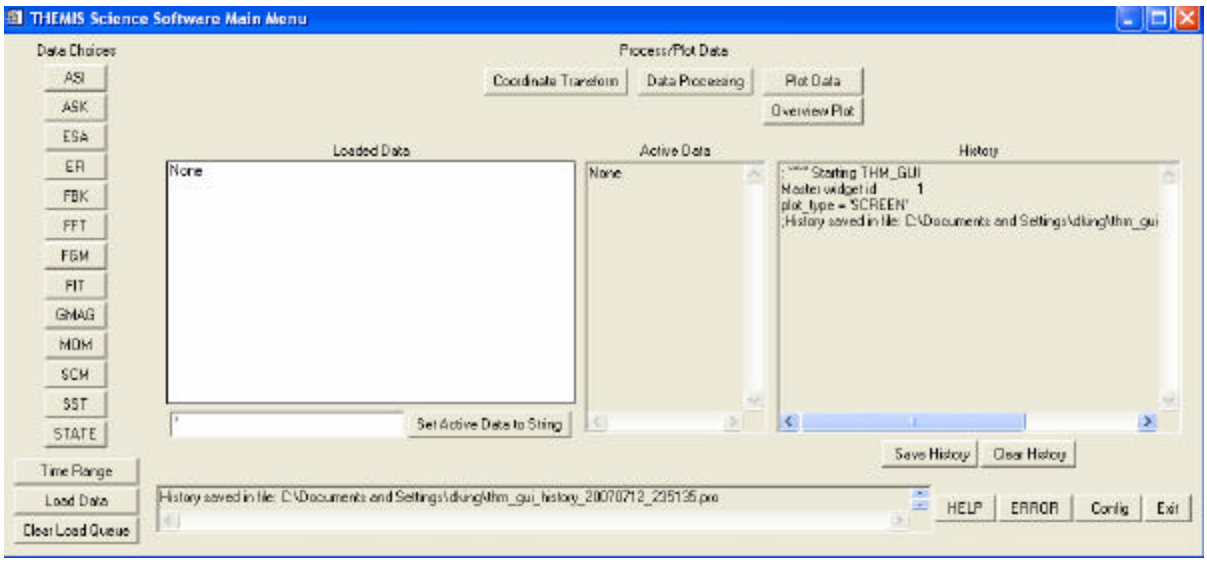
3.3 THEMIS Science Support Help Form - GUI Text Form

```
            THEMIS Science Help Request Form

thm_sci_help_request_xxxx (xxxx number will be sent back to you)

Date Submitted: _________

Request Type: __ (C-Comment, O-Observation, P-Problem, Q-Question)

Category: ___________ (Data, Document, Download, Gui, Instrument,
                  Plot, Software, Web Content, Other, Not Sure)

Title: ____________________________________________________

Requestor Info:
Name: _____________________  Office Phone: _____________
Email: _____________________

Help Request Details (fill in as much as you can):

If a Problem or Observation:
Date Occurred: _________
Operating System _______ (e.g. Linux, Unix, Windows)
CDF Version ____   Version of Software _____  Version of IDL____

Detail Description of Comment, Observation, Problem or Question:
(if applicable, please include IDL error messages, crib sheet or
 lines of code used to run and if using the GUI the History File)
_____________________________________________________________
_____________________________________________________________
_____________________________________________________________
_____________________________________________________________

Please email any supportive materials that would help in researching
your request to:THEMIS_Science_Support@ssl.berkeley.edu
with the Help Request Title above in the subject line.

Thanks so much,
THEMIS Science Support Team
```

3.4 Help Form Location - GUI Message Window



3.5 Saved History Location - GUI Message Window



4 THEMIS DATA

This section describes the THEMIS data, as seen by the THEMIS Data Analysis Software.

4.1 THEMIS DATA Overview

THEMIS data is available in 3 levels

Level 0	telemetry packet format, overlaps removed and formatted into daily files
Level 1	CDF data files, contain raw telemetry data
Level 2	CDF data files, calibrated data

4.2 THEMIS DATA Quantity Summary

The tables on the next two pages summarize the datatypes recognized by TDAS, and where there is a difference, the names of the corresponding tplot variable name.

Instrument	LeveL	Data_name	Data Type	Description
ASI	L1	asf		All sky imager full resolution images of 256x256 pixels
		ast		All sky imager thumbnail images of 32x32 pixels
ASK	L1	ask		All sky imager keogram images of 256 pixels
ESA	L0	peif_density		ESA Ion Density
		peif_en_eflux		ESA Ion energy spectrogram
		peif_t3		Diagonalized Ion Temperature
		peif_velocity_ds		ESA Ion Velocity DSL
		peif_velocity_gs		ESA Ion Velocity GSE
		peif_velocity_gs		ESA Ion Velocity GSM
		peef_density		ESA Electron Density
		peef_en_eflux		ESA Electron energy spectrogram
		peef_t3		Diagonalized Electron Temperature
		peef_velocity_ds		ESA Electron Velocity DSL
		peef_velocity_gs		ESA Electron Velocity GSE
		peef_velocity_gs		ESA Electron Velocity GSM
EFI	L1	vaf		EFI, Voltages, processor A fast survey/full orbit
		vap		EFI, Voltages, processor A particle burst
		vaw		EFI, Voltages, processor A wave burst
		vbf		EFI, Voltages, processor B fast survey/full orbit
		vbp		EFI, Voltages, processor B particle burst
		vbw		EFI, Voltages, processor B wave burst
		eff		EFI, E field, fast survey/full orbit
		efp		EFI, E field, particle burst
		efw		EFI, E field, wave burst
		eff_0		Electric Field E in 12, 34, 56 Sensor Coordinates
		efp_0		Electric Field E in 12, 34, 56 Sensor Coordinates
		efw_0		Electric Field E in 12, 34, 56 Sensor Coordinates
FBK	L1	fb1		Filter Bank 1 (E and/or B)
		fb2		Filter Bank 2 (E and/or B)
		fbh		Filter Bank High Frequency (100-300kHz)
	L2	fb_hff		High-Frequency Filter peak and average values
		fb_edc12		Spectrogram FBK EDC12
		fb_edc34		Spectrogram FBK EDC34
		fb_edc56		Spectrogram FBK EDC56
		fb_scm1		Spectrogram FBK SCM1
		fb_scm2		Spectrogram FBK SCM2
		fb_scm3		Spectrogram FBK SCM3

Instrument	LeveL	Data_name	Data Type	Description
FFT		ffp_16		FFT in particle burst x 16 frequencies
		ffp_32		FFT in particle burst x 32 frequencies
		ffp_64		FFT in particle burst x 64 frequencies
		ffw_16		FFT in wave burst x 16 frequencies
		ffw_32		FFT in wave burst x 32 frequencies
		ffw_64		FFT in wave burst x 64 frequencies
FGM	L1	fgl	float[3]	FGM Low Telemetry (low data rate)
		fgh	float[3]	FGM High Telemetry (high data rate)
		fge	float[3]	FGM Engineering Data (Decimated from FGH)
	L1 support data	fgl_hed	byte array	Header describing data rate
	L1 support data	fgh_hed	byte array	Header describing data rate
	L1 support data	fge_hed	byte array	Header describing data rate
	L2	fgs		FGS (spin-resolution) magnetic field B in XYZ Desp
FIT	L1	fit		SpinFIT file E&B raw data
		fit_fgs		FGM Spinfit calibrated data, dsl xyz
		fit_efs		EFI Spinfit calibrated data, dsl xyz
		fit_bfit		FGM Spinfit calibrated data: A,B,C,sig,avg
		fit_efit		EFI Spinfit calibrated data: A,B,C,sig,avg
GMAG	L2	mag		Ground Magnetometer data in DHZ coordinates
MOM	L1	mom		On-board ESA and SST Moments
SCM	L1	scf		SCM waveform Fast Survey
		scp		SCM waveform Particle Burst
		scw		SCM waveform Wave Burst
SST	L1	sst		Same as ESA
STATE	L1	pos	float[3]	GEI position, xyz
		vel	float[3]	GEI velocity, xyz
	L1 support data	man	int	Maneuver flag
	L1 support data	roi	int	Regions of Interest
	L1 support data	spinras	float	spin axis right ascension, deg
	L1 support data	spindec	float	spin axis declination, deg
		spinalpha		Geom to spin axis, Euler alpha, deg
		spinbeta		Geom to spin axis, Euler beta, deg
		spinper		spin period, sec
		spinphase		spin phase, deg

5. THEMIS DATA ANALYSIS SOFTWARE

The THEMIS Data Analysis Software (hereafter referred to as TDAS) is IDL-based. TDAS routines can be used to download, open, analyze and plot L1 or L2 data and process L1 data into L2 data quantities. There are two main ways to use the programs: with the command line interface, or with the GUI interface.

Other features include coordinate transformations and utility routines to translate data into other products (e.g., ascii) as necessary.

5.1 System Requirements

The THEMIS Data Analysis Software requires IDL developers license for Windows or a UNIX-like operating system like Solaris, Linux, or Mac OS X. The software has been tested on IDL 6.3, but should work on IDL 6.2 and 6.4. There is a patch to IDL, which is recommended for best handling of the CDF file format that is used by the THEMIS data files. See:
http://cdf.gsfc.nasa.gov/html/cdf_patch_for_idl6x_new.html
If you are using IDL 6.2 or earlier, or if you are using Intel Mac with any version of IDL (up to 6.4) you *must* install this patch to read CDF files properly.

Mac OS X notes:

You need X11 to view plots and use the GUI in IDL. You can search for X11 in the Spotlight to see if the X11 application is installed on your system. X11 is available on your Mac installation disks, but may not be installed by default.

There is a known problem, mentioned in the IDL 6.3 release notes, which affects all IDL users running Mac OS 10.4 (Tiger) The tlimit command will lock up IDL because the plot window will not receive any mouse clicks. Workaround: Change the X11 start-up para meters. Do the following:

1. Open any terminal window (in the X11 application menu bar, you can choose xterm from the applications menu)
2. Enter the following at the shell prompt:
   defaults write com.apple.x11 wm_click_through -bool true
3. Quit X11 (if it is running).

The new default will take effect the next time you start X11, and it will persist from that point (i.e., you will not have to make the change again).

.

5.2 Known Limitations

Incompatibilites with SolarSoftWare (SSW). There exist some name clashes if both TDAS and SSW are on your IDL_PATH.
ASI data: ASF (full resolution ASI data) requires a 64-bit machine to load more than 1 hour's worth of data.

5.3 Installation and Configuration

Getting started is usually as simple as of downloading the code and setting up your IDL path, according to the instructions, below.

For a new installation:

1. Download and expand the latest TDAS release .zip file. See section 2.3 THEMIS Science Software – Download Software.
2. Create a directory called TDAS into which you will copy the latest software.
3. Move the tdas_x_xx folder into the TDAS directory you created.

4. Configure IDL to search the TDAS directory for IDL programs. See section 5.3.1 IDL PATH setup.

For an upgrade of an existing installation of TDAS, as per the above 4 steps:

1. Remove old tdas_x_xx from the TDAS directory.
2. Download and expand the latest TDAS release .zip file.
3. Copy the new tdas_x_xx directory into the pre-existing TDAS directory.
4. Re-start IDL.

5.3.1 IDL PATH setup

5.3.1.1 IDL PATH Setup on Windows (and IDLDE on UNIX, Linux and Mac)

For Windows or IDLDE on UNIX, you can use the File->Preferences widget to set up the path so IDL can find the THEMIS IDL files.

> UNIX Note: If you use IDLDE on UNIX-like systems, these instructions only work if you do not set the IDL_PATH environment variable before you call IDLDE. If IDLDE does not allow you to set the path by following these instructions, then follow the instructions for UNIX installation, below.

Start IDL (Windows) or IDLDE (UNIX, Linux, Mac).

Go to File->Preferences
Select the 'Path' tab.

If <IDL_DEFAULT> is not present, press 'Insert Standard Libraries'

Press Insert
Browse to find the TDAS directory you created (see section 5.3 Installation and Configuration)
Check the box to indicate "search subdirectories"

5.3.1.2 IDL PATH Setup for IDL Command Line (UNIX, Linux or Mac OS X)

For the command line version of IDL, installation consists of setting up the IDL_PATH environment variable

Simply set the IDL_PATH environment to search all subdirectories of the TDAS directory you created in section 5.3 Installation and Configuration.

for csh or tcsh, place the following in your .cshrc file

```
setenv IDL_PATH '<IDL_DEFAULT>:+/path/to/tdas'
```

for bash or sh, place the following in your .bashrc (Linux, Solaris) or .bash_profile (Mac) file:

```
export IDL_PATH='<IDL_DEFAULT>:+/path/to/tdas'
```

> Mac OS X Notes:
> You can edit yor .bash_profile file using the standard Mac TextEdit program (normally, it's impossible to open 'hidden' files beginning with '.' using TextEdit or the Mac Finder)
>
> In the Terminal, type (or cut-and-paste)
> /Applications/TextEdit.app/Contents/MacOS/TextEdit ~/.bash_profile

That will open the .bash_profile file in the standard Mac text editor. The following configurations are recommended to enable you to use IDL from the Terminal.

```
# Configurations to make IDL and TDAS work from the Terminal
export DISPLAY=:0.0
IDL_LOC='/Applications/rsi/idl_6.3'
source ${IDL_LOC}/bin/idl_setup.bash
export IDL_PATH='<IDL_DEFAULT>:/path/to/tdas'
# End configurations for IDL and TDAS
```

Note that IDL_LOC may vary, depending on version of IDL installed. Search for actual location of IDL using Spotlight.

Tip:
You can drag the 'tdas' directory from the Finder into the TextEdit or Terminal window to paste the actual path for /path/to/tdas.

After saving the file, be sure to exit the TextEdit application from the menu bar, so you can get your command line prompt back!

5.3.2 Data Directory Setup

The THEMIS Data Analysis Software requires a local data directory in which THEMIS data files can be cached. The THEMIS will attempt to create the local data directory for you at the following default location, depending on your operating system.

OS	LOCAL_DATA_DIR
Windows	C:\data\themis
Solaris, Linux, Mac OS X	~/data/themis

These locations should work as-is for most installations; however, if you don't have administrative privileges to create the data directory in the above locations, you can have your system administrator create it for you, or you can configure the THEMIS Data Analysis Software to use an alternate location. See Remote Data Access and Local Data Cache for information about configuring an alternate location.

5.4 How to Get Started

Assuming you have the software installed, the best place to start is with a crib sheet. The crib sheets in the idl/themis/examples folder give end-to-end examples of how to load, process and plot the highest level data available for a given instrument.

Crib sheets in idl/themis/examples:

thm_crib_asi	Crib sheet for loading and displaying All Sky Imager and Keogram data.
thm_crib_efi	Crib sheet for Electric Fields Instrument waveforms.
thm_crib_esa_da	Crib sheet for analysis of ESA particle distributions
thm_crib_esa_moments	Crib sheet for ground processed ESA moments
thm_crib_export	Crib sheet for exporting THEMIS data and/or plots in common data formats.
thm_crib_fbk	Crib sheet for Filter Bank.
thm_crib_fft	Crib sheet for on-board Fast Fourier Transform data.
thm_crib_fgm	Crib sheet for Flux Gate Magnetometer
thm_crib_fit	Crib sheet for on-board Fields Spin Fit
thm_crib_gmag	Crib sheet for GMAG, including wavelet demo.
thm_crib_mom	Crib sheet for on-board particle Moments.
thm_crib_scm	Crib sheet for Search Coil Magnetometer
thm_crib_sst	Crib sheet for Solid State Telescope.
thm_crib_state	Crib sheet for State data – loading and plotting probe position data

thm_crib_tplot	Crib sheet for using tplot plotting package, using GMAG data as an example.
thm_map_examples	Examples for mapping Ground Base Observatories (GBO)

You can run any of the crib sheets by typing
`.run <thm_crib_xxx>`

when execution stops at a 'stop' command in the crib sheet, type
`.c`
to continue.

Alternatively, you can cut and paste from the crib sheet to the command line.

thm_map_examples is not in the same format as the other crib sheets: it defines some procedures which you can then run for yourself, or use as examples for your own code.

To find more information on any of the TDAS routines used in the crib sheets, use:

- The source code of the crib sheets, which is included in the idl/themis/examples directory of the software distribution.
- HTML help included with the software distribution: point your web browser to idl/_tdas_doc.html at the location where your TDAS software is installed locally.
- IDL XDOC widget. At the IDL prompt, type:
  xdoc
- IDL doc_library procedure. At the IDL prompt, type:
  doc_library, 'command_name'

Sample THEMIS routine documentation:

```
;+
;Procedure: THM_LOAD_GMAG,
; thm_load_gmag, site = site, datatype = datatype, trange = trange, $
;               level = level, verbose = verbose, $
;               subtract_average = subtract_average, $
;               subtract_median = subtract_median, $
;               varname_out = varname_out, $
;               subtracted_values = subtracted_values, $
;               downloadonly = downloadonly, $
;               valid_names = valid_names
;keywords:
;  site  = Observatory name, example, thm_load_gmag, site = 'bmls', the
;         default is 'all', i.e., load all available stations . This
;         can be an array of strings, e.g., ['bmls', 'ccmv'] or a
;         single string delimited by spaces, e.g., 'bmls ccnv'
;  datatype = The type of data to be loaded, for this case, there is only
;         one option, the default value of 'mag', so this is a
;         placeholder should there be more that one data type. 'all'
;         can be passed in also, to get all variables.
;  TRANGE= (Optional) Time range of interest  (2 element array), if
;         this is not set, the default is to prompt the user. Note
;         that if the input time range is not a full day, a full
;         day's data is loaded
;  level = the level of the data, the default is 'l2', or level-2
;         data. A string (e.g., 'l2') or an integer can be used. 'all'
;         can be passed in also, to get all levels.
;  /VERBOSE : set to output some useful info
;  /SUBTRACT_AVERAGE, if set, then the average values are subtracted
;                  from the loaded variables,
;  /SUBTRACT_MEDIAN, if set, then the median values are subtracted
;                  from the loaded variables,
;  varname_out= a string array containing the tplot variable names for
;               the loaded data, useful for the following keyword:
```

```
;  subtracted_values = returns N_elements(varname_out) by 3 array
;                      containing the average or median (or 0) values
;                      subtracted from the data.
;  /downloadonly, if set, then only download the data, do not load it
;                 into variables.
;  no_download: use only files which are online locally.
;  relpathnames_all: named variable in which to return all files that are
;         required for specified timespan, probe, datatype, and level.
;         If present, no files will be downloaded, and no data will be loaded.
;  /valid_names, if set, then this will return the valid site, datatype
;                and/or level options in named variables, for example,
;
;                thm_load_gmag, site = xxx, /valid_names
; get_support_data = does nothing.  present only for consistency with other
;                load routines
;
;Example:
;   thm_load_gmag, site = 'bmls', trange =
;   ['2007-01-22/00:00:00','2007-01-24/00:00:00']
;
;Written by: Davin Larson,   Dec 2006
; 22-jan-2007, jmm, jimm@ssl.berkeley.edu rewrote argument list, added
; keywords,
; 1-feb-2007, jmm, added subtract_median, subtracted_value keywords
; 19-mar-2007, jmm, fixed the station list...
; $LastChangedBy: jimm $
; $LastChangedDate: 2007-05-21 19:44:54 -0400 (Mon, 21 May 2007) $
; $LastChangedRevision: 678 $
; $URL: svn+ssh://thmsvn@ambrosia.ssl.berkeley.edu/repos/thmsoc/branches/QA/idl/themis/ground/thm_load_gmag.pro $
;-
```

5.5 Software Functions

This section described the functionality of the THEMIS software. The examples are given using the command line interface, but the concepts are the same for the GUI.

5.5.1 Loading THEMIS Data

The THEMIS software is set up to work with Level 2 THEMIS data by default. However, it can also be used to load Level 1 data, calibrate it, and output data quantities, which are essentially the same as the Level 2 product.

It is also possible to load raw Level 1 data. Calibration routines are available for those who want to have full access to intermediate outputs, settings of calibration parameters, diagnostic outputs, etc.

With the exception of ESA data, TDAS does not work with Level 0 data, and instead works with the Level 1 in CDF data format.

The THEMIS software will automatically create a local data cache which mirrors the structure of the THEMIS data archive. The software is written such that the default settings will work for the majority of users. The location of the THEMIS data archive is also found automatically by the software.

To download some data and load it into IDL, you simply specify a timespan and type of data you want to load. If the data does not exist locally on your local_data_dir, it will be downloaded automatically before it is loaded into IDL.

At the IDL prompt, type:

```
timespan, '2006-11-11', 1, /day
```

Then, use one of the thm_load commands, e.g.

```
thm_load_gmag, site='ccnv'
```

List of routines for loading data:

thm_load_asi	Loads All-Sky Imager data for any ground station (by keyword) or all available.
thm_load_ask	Loads All Sky Keogram data for all observatories.
thm_load_efi	loads efi waveforms
thm_load_esa	Load ElectroStatic Analyzer data (for L2 esa data)
thm_load_esa_pkt	Load Level 0 ESA data
thm_load_fbk	Load Filter Bank data
thm_load_ffg	Load on-board Fast Fourier Transform data.
thm_load_fgm	loads all fgm waveforms (choice of fgl, fgh…)
thm_load_fit	Load On-Board Fields Spin-Fit data
thm_load_scm	Load Search Coil Magnetometer data.
thm_load_gmag	loads ground mag data for any ground station (by keyword) or all available.
thm_load_hsk	loads housekeeping data – all or one by keyword.
thm_load_mom	loads on-board moments data (only density moment is currently valid)
thm_load_scm	loads SCM waveform.
thm_load_sst	Load Solid State Telescope data.
thm_load_state	Loads Orbit and Attitude data

Standard Load Procedure Keywords:

SITE	string: ground station name, or a list of ground station names, or ‘all’
PROBE	string: probe name, or a list of probe names, or ‘all’. e.g. ‘a b c’
DATATYPE	type of CDF file for the given instrument.
LEVEL	Level of data file to load: 'l1' or 'l2' default is ‘l2’ for Level 2.
TYPE	‘raw’ or ‘calibrated’. applies to ‘l1’ data only. ‘Calibrated’ is the default.
VALID_NAMES	Return valid names for DATATYPE, SITE, PROBE, and LEVEL
VERSION	Version of CDF file to load (useful for STATE data): 'v01', 'v02'
GET_SUPPORT_DATA	Get support data quantities from CDFas well as data quantities, only useful for ‘l1’ data.
CDF_DATA	Return a structure containing data and metadata from CDF.

5.5.2 General Conventions: variable name construction and reference

The command line interface of TDAS provides a general interface for referring to a data quantity, based on keywords. The lists in these keywords can be arrays of strings, or scalar strings containing space-separated lists.
PROBE : specifies the probe, or probes of interest: ‘a b c’ or [‘a’, ‘b’, ‘c’]
DATATYPE: specifies the type of data, for a given instrument: corresponds to name in CDF file
SUFFIX: a suffix to the variable name

the data is loaded into variables with the following name:
tha_bbb_suf
where a is the probe designation, bbb is the datatype designation, and _suf is the optional suffix.
For some data, a midfix is added before the datatype: e.g. for all STATE and HSK data a midfix is added before the datatype it in the TPLOT variable name. e.g.
tha_state_pos
In this example, the datatype is POS, but the state_ midfix had been added before it in the name.

The various thm_load and thm_cal routines, as well as thm_cotrans all accept the above keywords to determine which data to operate upon.

General-purpose routines (e.g. tplot) contained in TDAS can refer to sets of tplot variables using glob-style patterns:

th?_???_raw
Refers to data for all probes for all datatypes, and with any suffix.
th[ab]_fg?
Refers to FGL, FGH, FGE for probes A and B.

Some routines, (e.g. thm_cotrans) accept both conventions.

5.5.3 Plotting the data

In the command line, type
`tplot_names`
to see available data quantities. Type, e.g.,
`tplot, 1`
to plot the first quantity.

`tplot, [1,2,3]`
plots a stack plot of the first 3 data quantities.

`tplot, 'th?_fgh'`
plots a stack plot of High Rate Flux Gate Magnetometer data for all available probes.

Plotting routines:

tplot	General purpose time plotting utility for creating stack plots of waveforms and sonograms.
tlimit	Zoom into or out of a tplot
get_data	Get data out of a tplot variable into a structure containing a time tag array and a data array.
store_data	Store a data array structure into a tplot variable.

tlimit
zoom in.
tlimit, /last
zooms out again (or in again)
tlimit, /full
zooms to the full time range available.

You can also retrieve data from tplot variables and manipulate it in IDL. Refer to thm_crib_tplot for examples of using get_data and store_data.

5.5.4 Calibrations and Beyond

Refer to the crib sheet for each instrument for usage of the calibration routines. The interface to the various calibration routines has not yet been standardized.

Calibration: from L1 data to physical quantities

thm_cal_efi	Electric Fields Instrument
thm_cal_fbk	Filter Bank
thm_cal_fft	FFT data
thm_cal_fgm	Flux gate magnetometer
thm_cal_fit	same as thm_cal_sst, above, but for ESA data.
thm_cal_mom	calibrates all (ESA and SST) moment data
thm_cal_scm	calibrate SCM data

For working with SST or ESA data, see the crib sheets.

5.5.5 Coordinate Transformations

thm_cotrans can be used to transform a THEMIS vector data quatity stored in a tplot variable to any of the following coordinate systems:

Abbreviation	Description
SPG	Spinning Probe Geometric
SSL	Spinning SunSensor L-vectorZ
DSL	Despun SunSensor L-vectorZ
GEI	Geocentric Equatorial Inertal
GSE	Geocentric Solar Ecliptic
GSM	Geocentric Solar Magnetospheric

For details and diagrams, see THM_SOC_110_COORDINATES.

The default output of thm_load routines is DSL. The thm_load routines set metadata in the tplot variable, which indicates the coordinate system of the data. Thm_cotrans is aware of this metatdata, so it is not necessary to specify thin input coordinate system when calling thm_cotrans.

thm_cotrans usage:
;Procedure: thm_cotrans
;Purpose: Transform between various THEMIS and geophysical coordinate systems
;keywords:
; probe = Probe name. The default is 'all', i.e., transform data for all
; available probes.
; This can be an array of strings, e.g., ['a', 'b'] or a
; single string delimited by spaces, e.g., 'a b'
; datatype = The type of data to be transformed, can take any of the values
; allowed for datatype for the various thm_load routines. You
; can use wildcards like ? and [lh].
; 'all' is not accepted. You can use '*', but you may get unexpected
; results if you are using suffixes.
; in_coord = 'spg', 'ssl', 'dsl', 'gse', 'gsm', or 'gei'
; coordinate system of input.
; This keyword is optional if the coord_sys attribute
; is present for the tplot variable, and if present, it must match
; the value of that attribute. See cotrans_set_coord, cotrans_get_coord
; out_coord = 'spg', 'ssl', 'dsl', 'gse', 'gsm', or 'gei'
; coordinate system of output.
; in_suffix = optional suffix needed to generate the input data quantity name:
; 'th'+probe+'_'datatype+in_suffix
; out_suffix = optional suffix to add to output data quantity name. If
; in_suffix is present, then in_suffix will be replaced by out_suffix
; in the output data quantity name.
; valid_names:return valid coordinate system names in named varibles supplied to
; in_coord and/or out_coord keywords.
;Optional Input Parameters:
; in_name Name(s) of input tplot varabiable(s) (or glob patern) (space-separated; string list or array of strings.)
; out_name Name(s) of output tplot variable(s). glob patterns not accepted.
; Number of output names must match number of input names (after glob

```
;         expansion of input names).  (single string, or array of strings.)
;
;Example:
;  thm_cotrans, probe='a', datatype='fgl', out_coord='gsm', out_suffix='_gsm'
```

Several examples of thm_cotrans usage can be found in thm_crib_fgm.pro.

A low-level coordinate transformation routine is available if working with simple arrays rather than tplot variables is desired.

cotrans	Transform between geophysical coordinate systems GSE, GEI, GSM.

5.6 Data Export

You can export your data and/or plots to a variety of data formats.
Examples:
Export to ASCII files:

```
tplot_ascii, 'th?_fgs', trange=timerange(/current), dir='~/thm/waves', ext='_20070520.txt'
```

This example writes out Flux Gate Magnetometer Slow Survey data for all probes.
The ext keyword is being used to add the time of the data to the filename.
The dir keyword is being used to set the directory to which the files will be written.

5.7 Managing Your Data Cache

There currently exist some experimental routines for managing your THEMIS data file cache. These routines serve as an example of how you will be able to download all data for a given time range with a single command.

- thm_file_download – can be used to download all types of THEMIS data for a given time span.
- thm_file_cleanup – delete empty directories. This is a function call. It searches the hierarchy and return files matching a given pattern, sorted by access time. Currently does not delete files, but can be used as a tool for finding old data.

5.5.8 Configuring Local Data Cache and Remote Access Behavior

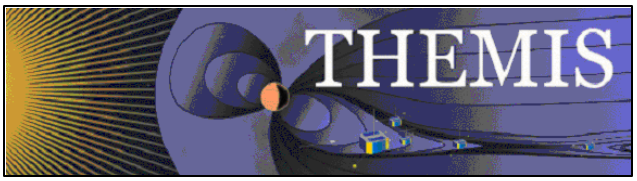
Data locations may be configured at IDL startup (for example, if you want the data to reside in a non-standard location), or dynamically during an IDL session.

The following table summarizes the controls that can be used, in order of precedence:

- !THEMIS system variable
- thm_config.txt (editable with thm_ui_config)
- environment variable settings

The following table summarizes the settings available:

!themis structure element	Environment Variable	Description
local_data_dir	THEMIS_DATA_DIR	a writable, local directory in which to cache data files
remote_data_dir	THEMIS_REMOTE_DATA_DIR	URL to a data archive where THEMIS data can be found. By default, http://sprg.ssl.berkeley.edu/data/themis
no_download	N/A	1: don't access remote_data_dir
no_update	N/A	0: download only if file on server differs or if local file does not exist. 1: download only if local file does not exist. i.e. no clobber.



progress	N/A	0: don't show progress bar 1: show progress bar for each file downloaded.
verbose	N/A	level of verbosity for themis commands, 0=silent. Values >1 are generally for debugging.

5.5.8.1 Configuration at startup

If you want to change the local_data_dir where data will be stored, run
thm_ui_config
at the IDL prompt.
Change the setting for Local Data Directory and press 'Save' this will save the configuration to be used in all future IDL sessions. The configuration is saved in a thm_config.txt file in an OS-specific location.

5.5.8.2 On-the-Fly configuration

The local data directory location can be changed on-the-fly by setting the !themis.local_data_dir system variable. For example, when you are connected to the network, you may choose to use a networked data dir:

```
!themis.local_data_dir = '\\justice\data\themis\'
```

The remote_data_dir structure element can also be updated to a different URL.

If you want the software to use only locally available data, and don't want the software to try to download data, you can set:

```
!themis.no_download = 1
```

Note that you can only set the !themis variable in an IDL session after a thm_ command has already been run, or after explicitly calling thm_init.

Using thm_ui_config from the IDL prompt without pressing 'Save' in the widget is an alternate way of setting !themis for the current IDL session.

5.6 Software Organization

The themis directory contains THEMIS-specific routines. The general directory (currently named ssl_general) contains routines which are useful for more than one space-science mission for which THEMIS team members are developing code. The external directory contains packages developed and maintained by other groups, but which are required for writing (and running) the themis and/or general routines.

The idl directory of the distribution includes the following files and sub-directories.

_tdas_doc.html	Documentation in HTML format, including alphabetical list of all routines.		
themis/	setup_themis	Sample setup script for csh (UNIX)	
	ground/	routines for loading, processing and plotting ground-based data. e.g. thm_load_gmag, thm_gmag_stackplot, imageplot, mosaicplot	
	spacecraft/	fields/	routines for loading, processing and plotting particles data, e.g. thm_proc_fgm
		particles/	routines for loading, processing and plotting particles data, e.g. thm_load_sst, thm_cal_sst
	state/	Routines for reading state and performing coordinate transformations, e.g. thm_load_state, thm_cotrans.	

	examples/	Crib sheets, like thm_crib_ask
	common/	THEMIS-specific tools useful to multiple data types and instruments, eg thm_gui, thm_file_download, thm_init
ssl_general/	CDF/	CDF utilities, including cdf2tplot, and other utilites like cdf2tplot, cdf_info, cdf_load_vars (into IDL structure representation of CDF)
	science/	Routines useful for specific scientific analysis.
	cotrans/	General coordinate transformation: cotrans, ssl2dsl, dsl2gse
	tplot/	General time -plotting utilites
	misc/	Miscellaneous routines used by tplot and other ssl_general routines.
	key_param/	Load routines for ACE, KP, WIND, POLAR data.
external/	CDAWeb	

The _tdas_doc.html file contains a complete listing of all routines in the hierarchy, along with links to complete documentation.

6. Graphical User Interface

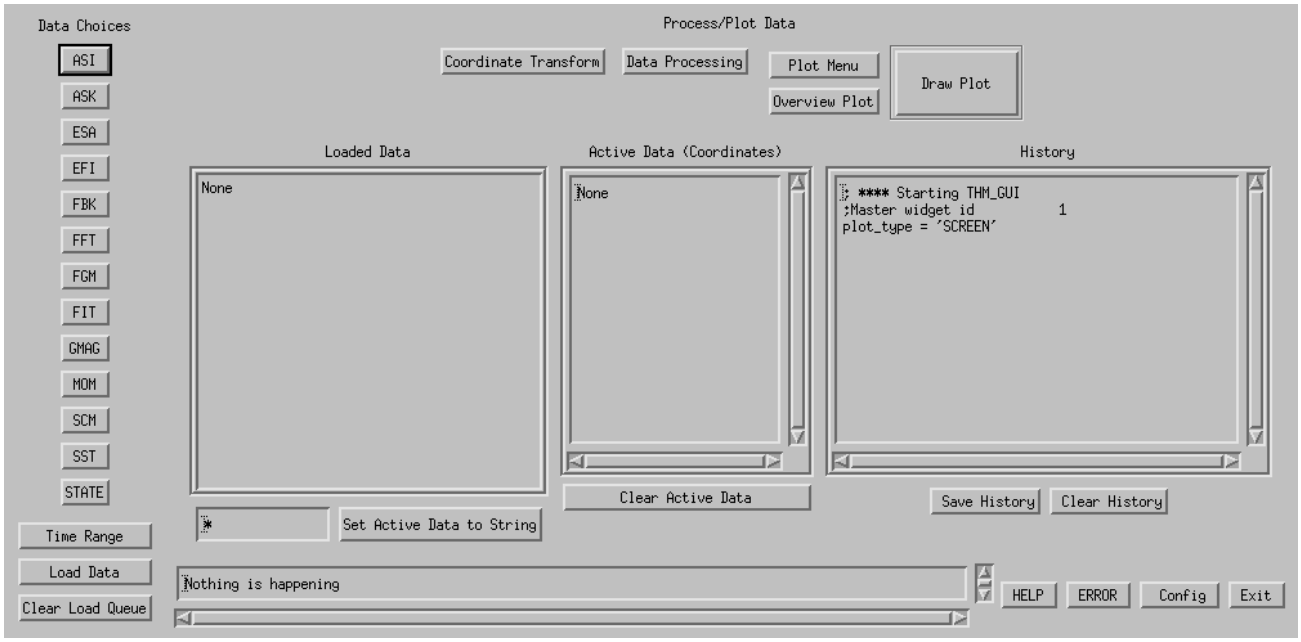
The philosophy of the graphical user interface (GUI) is to provide a convenient interface to the most generally useful capabilities of the command-line THEMIS IDL routines. General users can use the GUI without being required to know the individual IDL routines. Users who want a jump-start to using the more powerful and customizable IDL programming interface may begin with the GUI and then use the GUI to generate a script of the underlying IDL commands which perform the same function. This script can then be used as a starting point for creating an IDL program to process THEMIS data, or can be used as a crib sheet for using the THEMIS IDL programming interface.

The GUI code is bundled together with the THEMIS IDL code distribution; they are downloaded and installed as a single package.

A text-only version of the documentation for the GUI is available within the software distribution at idl/themis/examples/thm_gui.txt.

The GUI is comprised of a series of windows (also known as widgets) and sets of buttons and popups. The user navigates through these options by simply clicking on the option wanted.

6.1 Main Window



Starting from the left, the buttons in the first column (under "Data Choices") on the left side are used to choose different kinds of data to load, to choose the time range for the data, and to load the data. There is a button for each instrument, a button for time range selection, a button which initiates the

loading process and a button which clears the queue for loading data. Each of these buttons (except for the load/clear load buttons) pops up a selection widget.

The buttons across the top in the middle are for coordinate transforms, data processing, plotting and overview plots. When clicked, each of these buttons pops up a widget for different data manipulation tasks. If the "Draw Plot" button is clicked, a plot of the data is created.

In the middle of the window there are windows which show the data sets that have been loaded and selected and the history of IDL commands.

On the bottom of the main window there is a one-line progress widget that informs the user about the status of the current data loading or processing. Also there are buttons: "Help", "Error", "Config" and "Exit". The Help button pops up a text widget that shows this text. The Error button pops up a widget with the THEMIS help request form, which can be edited, saved and emailed. The Config button pops up a widget that allows the user to set different parameters in the system variable that controls automatic downloading. The Exit button ends the program.

6.1.1 Loaded Data Window

When data is loaded, information appears in the window. For each data set loaded, the appropriate variable name and time range are listed. To choose a particular data set for plotting or other processing, left-click on it. Multiple data sets can be selected by holding the "control" key, and clicking more than one. Also, you can click on an option, then hold "shift" and the left mouse button, and drag the cursor over the other data sets. Each of the data sets includes one "tplot variable", which can be processed and plotted using the IDL program TPLOT. The data sets that you click on in the Loaded Data window are called the "active" data sets.

6.1.2 Choosing Data Using Strings

Just below the Loaded Data window is a window in which the user can type in a string (or a set of strings separated by spaces) and set the active data sets to the variables including those strings. For example, typing in "tha_spin* tha_fg*" (don't include the quotes in the actual window) will set the active data sets to all variables that start with the string "tha_spin" and also all variables with names starting with the string "tha_fg". The question mark can be included as a wild card for single characters: e.g., "th?_spin*", will return all variables with "th" then one letter, then "_spin*. Once the string is typed, click on the "Set Active Data to String" button, and the appropriate data sets will become active. If you type "*" in the window, and click the "Set Active Data to String" button, all of the data available will be set to active.

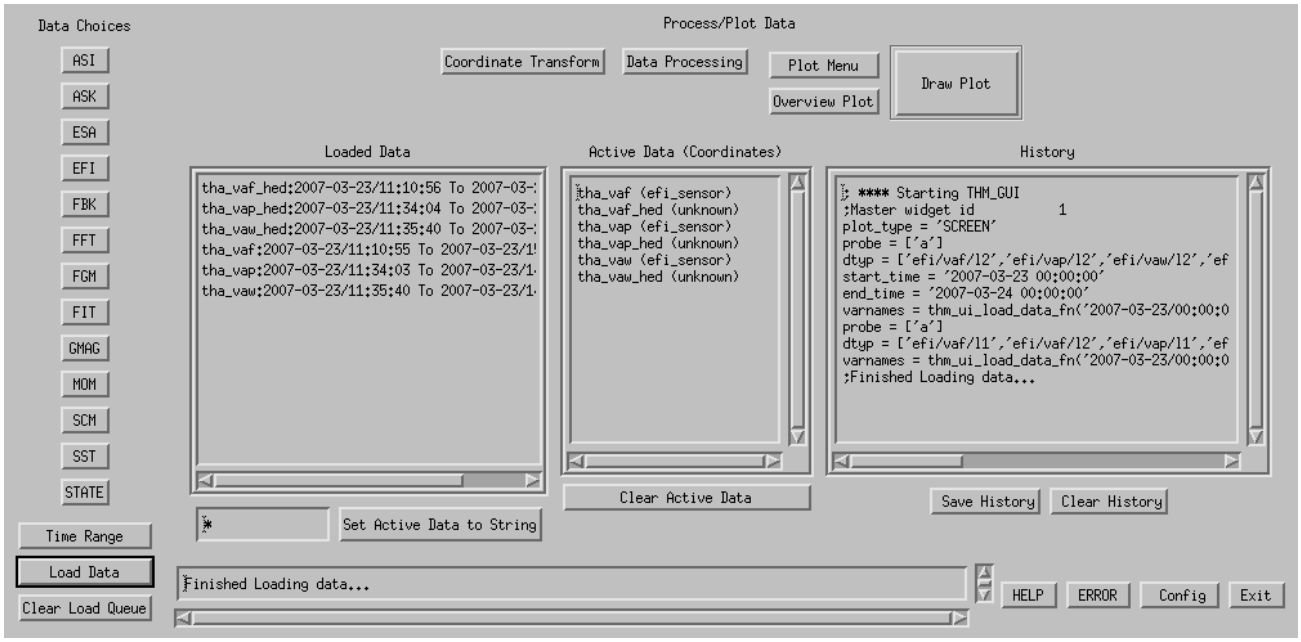
6.1.3 Active Data Window

In this window, the "active" data sets are shown. The data sets that you click on in the Loaded Data window are called the "active" data sets. Any coordinate transform, data processing or plotting task will refer to thse data only.

Right after you load data, then the "active" data sets are those which have just been loaded. Usually a data processing task will change the active data set to be the data that has been just been created. When you are in doubt which is the active data set, click on it and it will be set.

The coordinate systems of the active data sets are shown in parentheses after the variable name for informational purposes. "(Unknown)" means that there is no coordinate system associated with that data. This is shown in the screenshot below, which shows the state of the widget after loading data. If you click the "Clear Active Data" button below the window, the active data is cleared. The window is also cleared and the active data sets become inactive. No data is deleted. Just click on data in the loaded data window to activate it.

6.1.4 History Window



This is a list of the IDL commands which have been used, and error messages. Just below the history window are buttons that allow the user to save the history in a file, and clear the history. The "Save History" button will save the history in an IDL source file. When you click here, a file selection widget pops up, allowing you to choose the filename and path for the file. The default file is "thm_gui_history_yyyymmddss.pro" in your local working directory. The time stamp on the default

file name is the local system time. The "Clear History" button deletes the history. Since this history includes error messages, it is hoped that users will save and email this file when errors occur. This will be used as a debugging tool.

6.1.5 Progress Window

In this window, at the bottom of the main widget, there is a line of text that tells the user what is happening, with respect to data loading and processing tasks. It will also display warnings; in particular, when an invalid input value for some data processing task is input, there will be a warning in the progress widget. If there is an error that causes the code to crash, then this window will display the string "Error - See History:" to alert the user to an error.

6.1.6 Data Choices Selection Buttons

Each data choices selection button pops up a widget that shows the different types of data that can be loaded for that instrument. For ground-based data the list on the left gives the different ground stations that are available. For spacecraft data, the choice is of the different probes. To choose data from that station/probe, click on it. Multiple stations/probes can be selected by holding the "control" key, and clicking more than one. Also, you can click on an option, then hold "shift", and the left mouse button, and drag the cursor over the others. Clicking "*" will select all available ground stations or probes. The example in the screenshot below is for EFI data.

The types of data that are available are listed in the middle, for level 1 data, and on the right for level 2 data. Click on the type of data to choose it, multiple selections and "*" are handled in the same manner as the choice of ground station or probe.

Below these windows, there is a place to type in a string for the data selection. If you type in here, the data types that match this string are then displayed in the list windows. Wild card characters are necessary. If for example, you are selecting state data, and you wanted all data types that include "spin", then you type "*spin*". If there are no matches, “None” is displayed. Note that you still need to click on something in the list window to choose the data, even if there is only one variable available. Below this window, there are windows that show what the current data that is being selected and the probe or ground station selected. If no data types are selected, then no data for that instrument will be loaded.

There are 3 buttons, one that allows the user to clear the choice of probe/station, one that allows the user to clear the chosen data types, and one that exits the widget. When you are done, click the "Accept and Close" button to exit the popup. The chosen data types will show up in the history window. Occasionally, the highlighted data types/probes/stations may not match what is displayed in

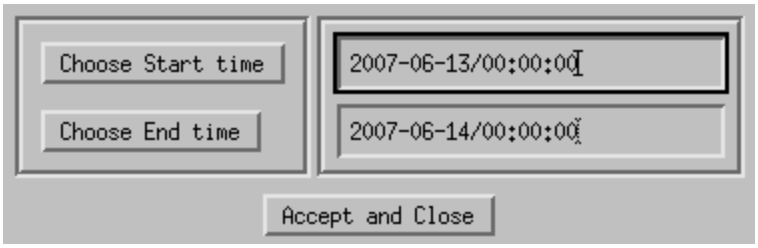
the bottom windows – if you clear the data types or probes, then the values are cleared, even if the highlights remain on the upper windows.

The GUI is set up to allow data from multiple instruments to be input together. For example, the user can choose some EFI data types, and some FGM data types, and some other types, and load it all with one click on the "Load Data" button. Note that the selection of "probe" is global. All of the selected data will be loaded for the probe(s) chosen most recently. If, for example, you want to load EFI data from probe "A" and FGM data from probe "B", you will need to load these separately.

You will notice that all of the other buttons on the widget are inactive while this popup is active. You must click on "Accept and Close" for anything to happen after you choose data types.

The data names can be cryptic, and are not necessarily clear to the casual user. Please see Section 4.2 for a list of data types, with some description.

6.1.7 Time Range Selection Button



Choose Start Time: Pops up a widget that allows you to choose a start time for data to be loaded. You may also type a string value of the form yyyy-mm-dd/hh:mm:ss in the window next to the button. The selected time is displayed in the history window. This allows the user to check that the time is correct, before loading data.

Choose End Time: Pops up a widget that allows you to choose an end time for data to be loaded. You may also type a string value of the form yyyy-mm-dd/hh:mm:ss in the window next to the button.

When you are done, click the "Accept and Close" button to exit the popup.

Note that the initial times are 1970-01-01/00:00:00. You are required to choose a time range before you can load any data. Once an initial time range is set, it is saved, and when the widget is popped up later in the session, the most recent inputs are displayed. You need not type or select a full time; all you have to do is edit.

6.1.8 Load Data Button

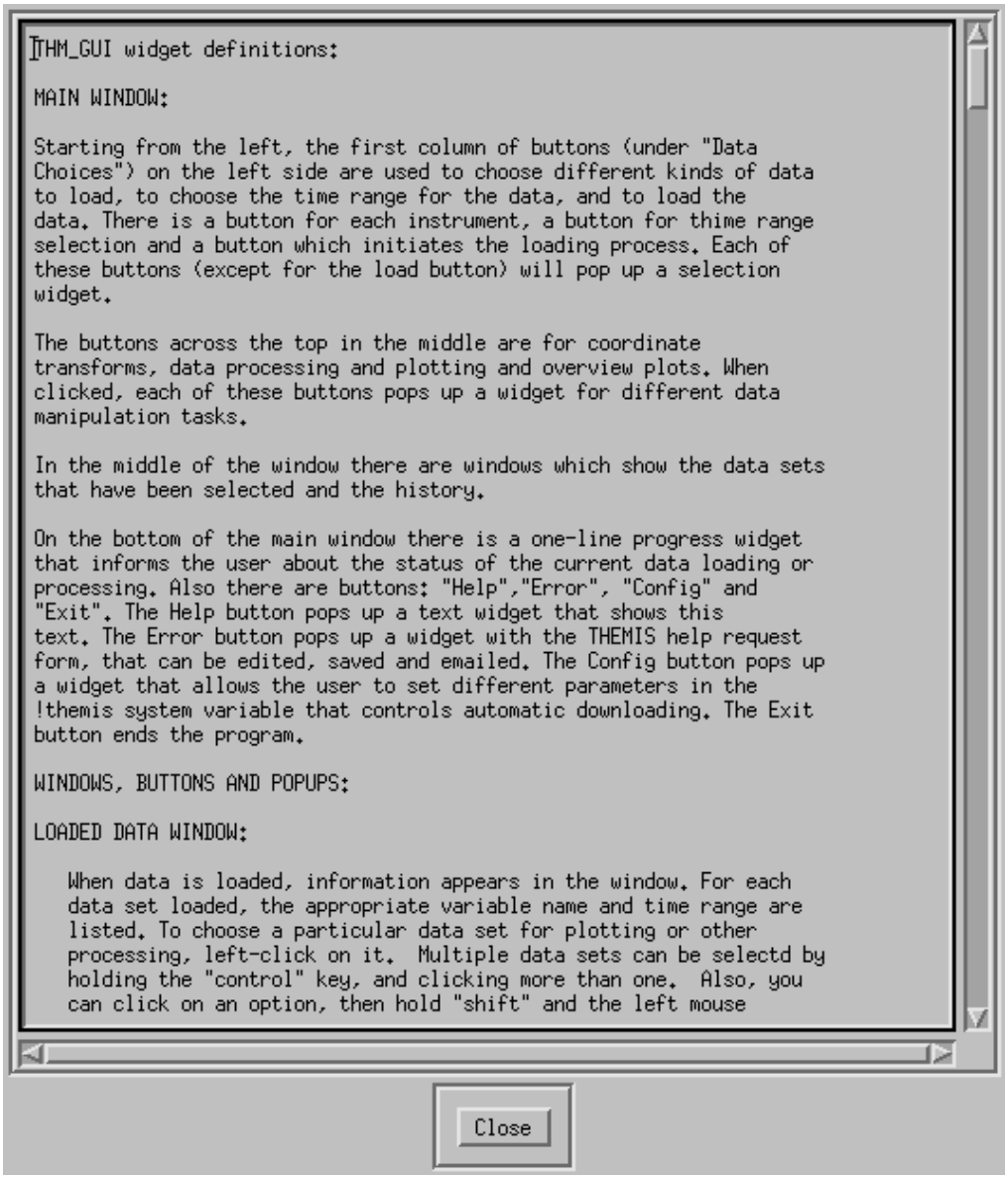
Click on this button to load the selected data. All selected data types will be loaded. The list of loaded data types, or "Load Queue" are saved. If you want to reload the same data for a different time range, you can simply change the time range and hit the load button. This only works if you haven't chosen any other data types, though. The list of data types is re-initialized when you click a data selection button after loading. As discussed above in section 6.1.3, the data sets loaded in the most recent button click are the "active" data sets and will appear in the Active Data window.

6.1.9 Clear Load Queue Button

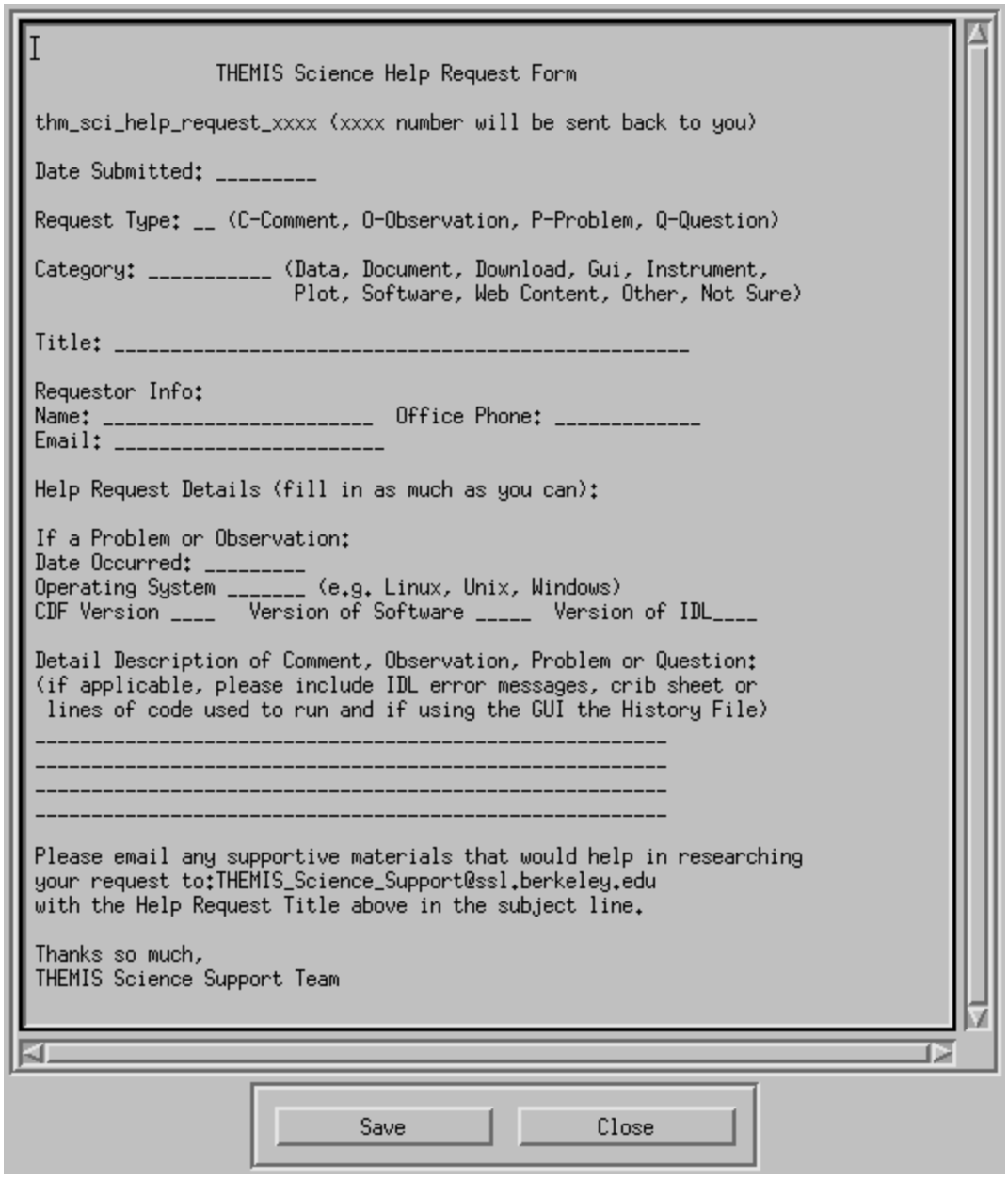
Click this button to clear out the load queue. This is useful if a load request failed. If the load routine crashes (heaven forbid), then it is a good idea to clear out the queue before trying to load other data.

6.1.10 Help Button

Clicking on the "HELP" button displays the text from this document related to the GUI. Clicking “Close” closes the widget.



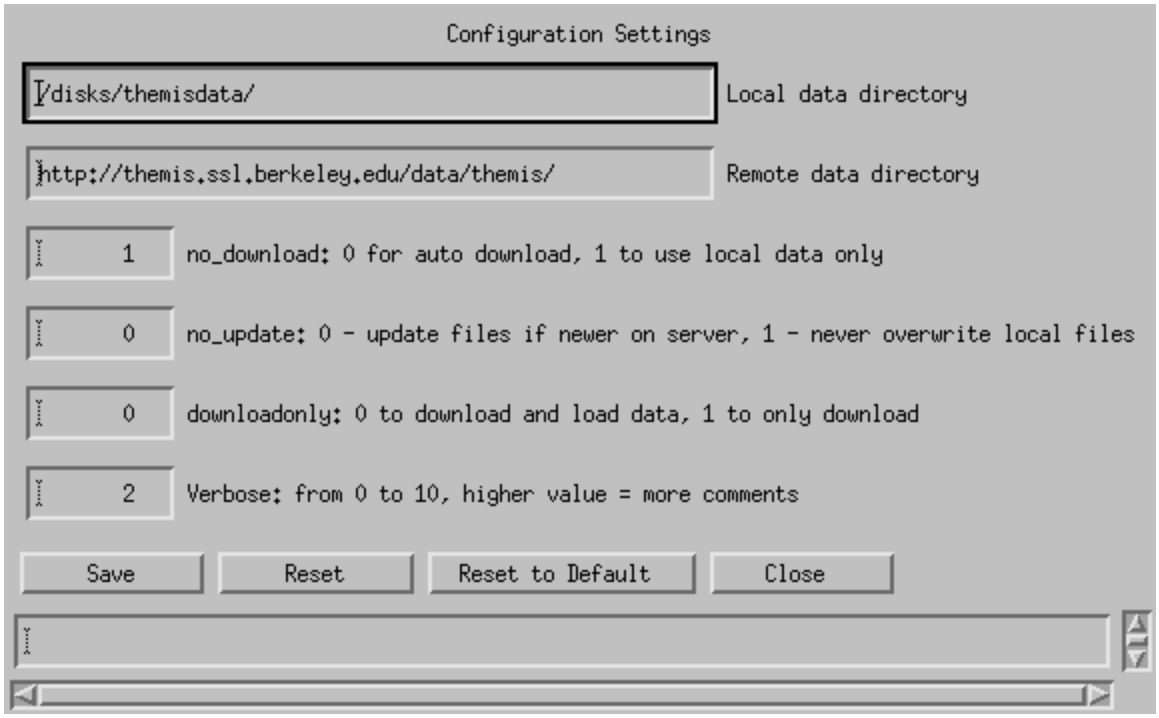
6.1.11 Error Button



When this button is clicked, an editable text widget pops up displaying the THEMIS Science Help Request Form. This allows the user to input information about the error which has occurred. There is a save button, which saves the request in a file, which can be emailed to THEMIS_Science_Support@ssl.berkeley.edu. Click "Close" to dismiss this widget.

IMPORTANT NOTE: This error widget also pops up automatically when processing errors occur. The Error button should only be needed if everything else fails.

6.1.12 Config Button



This button pops up a widget that allows access to the system variable that controls the automatic downloading process. You can type in values for the different options in the windows. Note that you should not need to do this very often.

The top window gives the local data directory. Any THEMIS data downloaded is expected to be downloaded into this directory. The default value for users who are logged on to an ssl.berkeley.edu machine is "/disks/data/themis/". For windows users, the default value is "C:\data\themis\". It can be set to any directory for which the user has write permission.

The second window shows the remote data directory. The default is "http://themis.ssl.berkeley.edu/data/themis/"

Next is the flag for automatic downloads; set this to 0 for automatic downloads, 1 for no automatic downloads. (This should be set to 1 for local SSL users, or anybody who has the entire database stored locally).
Next is the flag for file updates, if set to zero this will update files in local data directories if there is a file in the remote data directory which has the same name, but is new. If set to 1, then this is not done.
Next is the download only flag; Set this to 0 to download and load data, set to 1 to only download data, and not load.
Last is the verbose flag, set this to a number from 0 to 10. The higher the number, the more messages you get during processing.

6.1.12.1 Reset

If you press this button, the configuration is returned to the state which existed before you popped up the widget.

6.1.12.2 Reset to Default

If you press this button, the configuration is returned to the default state in THM_CONFIG.pro, and any saved configuration file is deleted. This means that if you want to go back to a configuration that you have saved previously, you need to reset the values and then save the configuration. Alternatively, you can locate the previously saved file and copy it to the appropriate location in the APP_USER_DIR shown below.

6.1.12.3 Save

If this button is pressed, then the current configuration is saved in a file. This file ends up in a directory created by the IDL APP_USER_DIR routine, on a windows system the path looks like this: "C:\usernme\.idl\themis\thm_config-4-win32\thm_config.txt". On a linux machine, it looks like: "$HOME/.idl/themis/thm_config-4-linux/thm_config.txt"

Important: Once you have saved this file, it will always be read when you run any THEMIS routines -- you should only need to do this once for each operating system that you are using.

Whenever you save a new file, the old file is copied to a file tagged with the current date and time, for retrieval in case of disaster.

6.1.12.4 Message Window

This message window will alert the user when an invalid input parameter is set. The text is the same as in the progress window of the main GUI.

6.1.12.5 Close Button

Closes the configuration widget

6.1.13 Exit Button

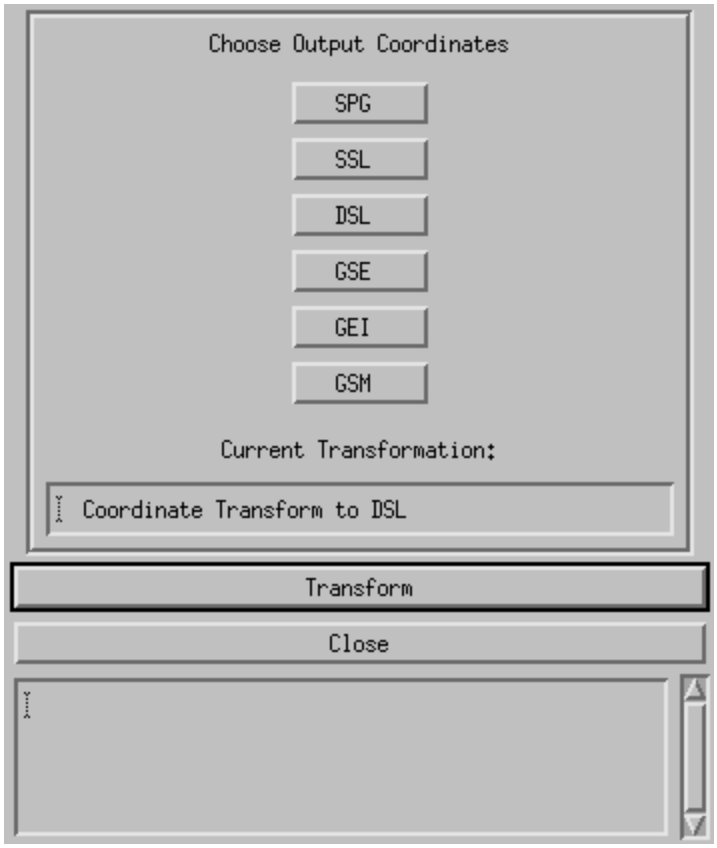
Exits the program, and closes all of the popups, except for the Help, Error and Configuration widgets, which are designed as stand-alone widgets.

6.2 Coordinate Transform Widget

When the "Coordinate Transform" button is clicked, a popup appears with different choices for coordinate transforms. Each possible output coordinate system has a button. The possibilities are: "SPG" (Spacecraft Probe Coordinates), "SSL" (Spinning Spacecraft Coordinates), "DSL" (Despun Spacecraft Coordinates), "GSE" (Geocentric Solar Ecliptic), "GSM" (Geocentric Solar Magnetospheric), and "GEI" (Geocentric Earth Inertial). A window below the buttons shows the current output coordinate system.

Only the active data sets are transformed. The input coordinate systems for the active data sets are automatically obtained. Data with "Unknown" coordinates will not be transformed.

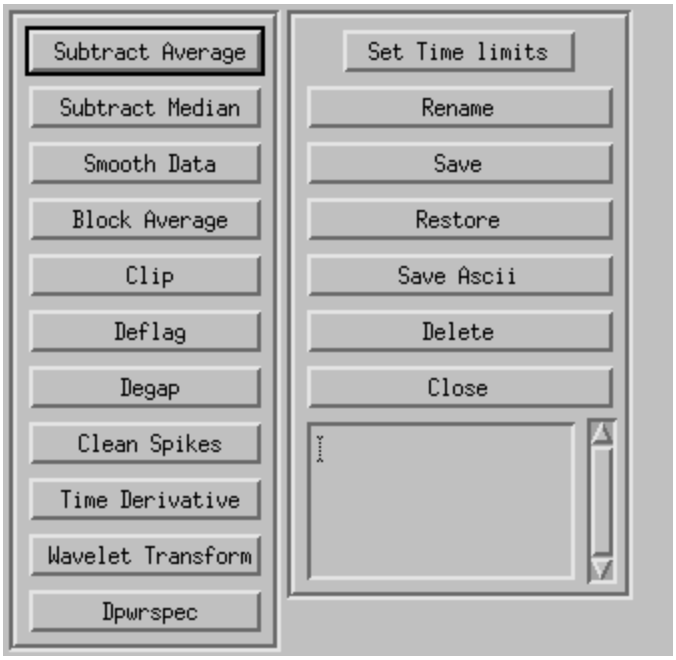
Click on the "Transform" button to perform the transformation. Warnings and error messages will appear in the window at the bottom, and also in the progress window on the main widget.



Click on the "Close" button to dismiss the popup.

6.3 Data Processing Widget

When the "Data Processing" button is clicked, a popup appears with various options for data processing. Only one data processing popup will appear; if you click the button multiple times, the same popup will show up. The popup contains multiple buttons and a text widget which displays messages. When one button is clicked, the other buttons are disabled.



Only the variables shown in the Active Data window will be operated on by these processes. Also, these processes change the active data sets to the output variables of the processes. If you want to do multiple processes on the same data sets, you need to reset the active data sets each time.

6.3.1 Message Window

In addition to alerting the user when a process crashes, the message window will alert the user when an invalid input parameter is set for the processes. The text is the same as in the progress window of the main GUI. For user input errors, the THEMIS Error widget does not pop up. It is important to note, however, that the user input error checking in IDL does not catch everything with respect to values typed into a widget. If the necessary input is a numerical value, then most strings that are not true numbers will not be rejected. For example, if a user inputs "XDFB%%%", this is interpreted as a value of zero; IDL does not stop processing when there is a type conversion error, it simply returns zero. Unusual things can happen. If the user inputs "1apppk", then this is interpreted by IDL as one, but if the user inputs "a1pppk", then this is interpreted as zero. If there seems to be a problem, and no error message pops up, look at the history window in the main GUI. The input values will be recorded there.

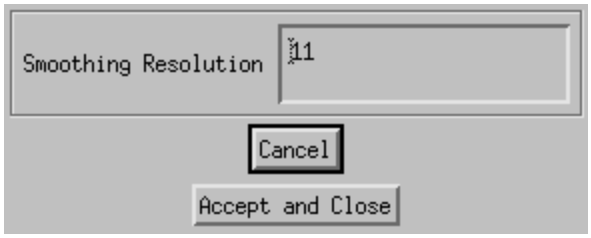
6.3.2 Subtract Average

For each active data set, the average value is subtracted. new variables are created, the new names have the syntax: new_var = old_var+"-d", and the new variables become the active data sets`.

6.3.3 Subtract Median

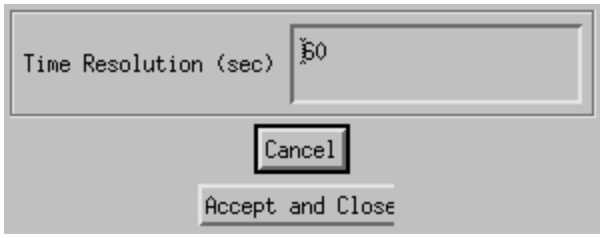
For each active data set, the median value is subtracted. new variables are created, the new names have the syntax: new_var = old_var+"-m", and the new variables become the active data sets.

6.3.4 Smooth Data



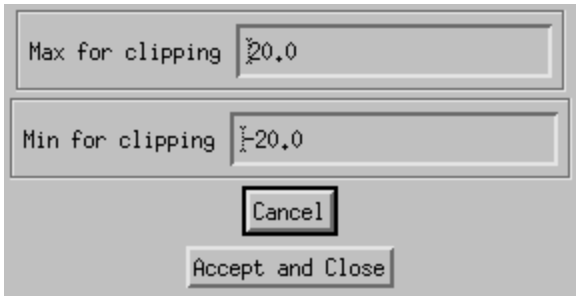
Boxcar smoothing of the data. A widget will pop up, asking how many data points to smooth over. Choose a value, and click on "Accept and Close". The default is 11 points. New variables will be created, with "_sm_npts" appended to the old variable names, where npts is the smoothing resolution. Click “Cancel” to cancel the operation.

6.3.5 Block Average



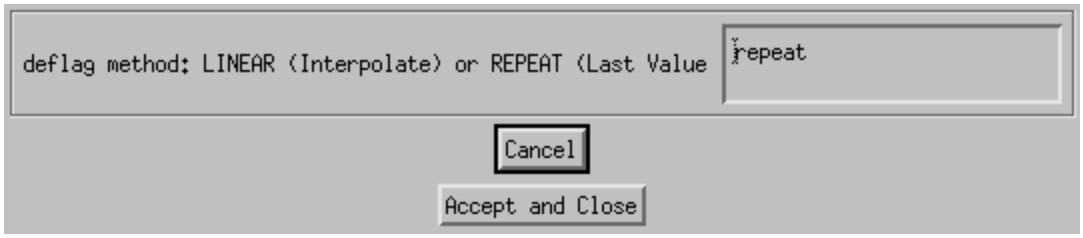
Click this button to average that data over time; a window will pop up, asking for the time resolution. The default time resolution is 60 seconds. New variables will be created, with "_av_tres" appended to the old variable names, where "tres" is the time resolution. Click “Cancel” to cancel the operation.

6.3.6 Clip



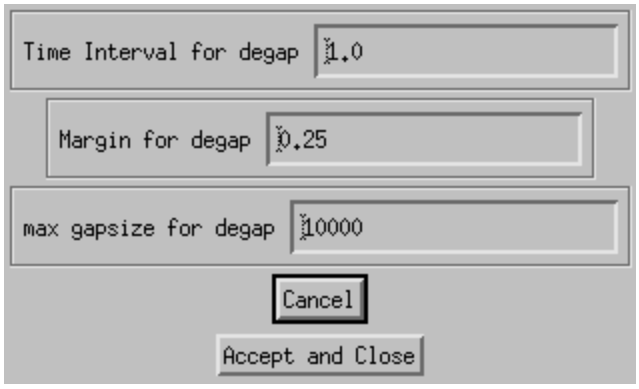
Clips data above and below a set maximum and minimum, a widget pops up which allows these values to be set. Then data outside the range is set to NaN. New variables will be created, with "_clip" appended to the old variable names. Click “Cancel” to cancel the operation.

6.3.7 Deflag



Interpolates or repeats the most recent valid data value over gaps in the data (gaps are denoted by NaNs, and can be created by the clipping process). A window pops up which is used to set the method, there are two choices: "repeat" will repeat the last good value over the gap; "linear" will interpolate over gaps. New variables will be created, with "_deflag" appended to the old variable names. Click “Cancel” to cancel the operation.

6.3.8 Degap



The degap procedure locates gaps in data, and fills them in with 'NaN' values, so that the plotting process displays the data gaps correctly (Otherwise it simply draws a line across the gap). It figures out where to add data points by checking which time differences are greater than or equal to an input time interval, plus a margin, and inserts equally spaced 'NaN' data points at time intervals with spacing determined by the size of the data gap divided by the number of points that fit with minimum cumulative error. Click “Cancel” to cancel the operation.

6.3.9 Clean Spikes

Removes large spikes from messy data. New variables will be created, with "_dspk" appended to the old variables.

6.3.10 Time Derivative

Takes the time derivative of the active data sets. New variables will be created, with "d_" prepended to the old variable names.

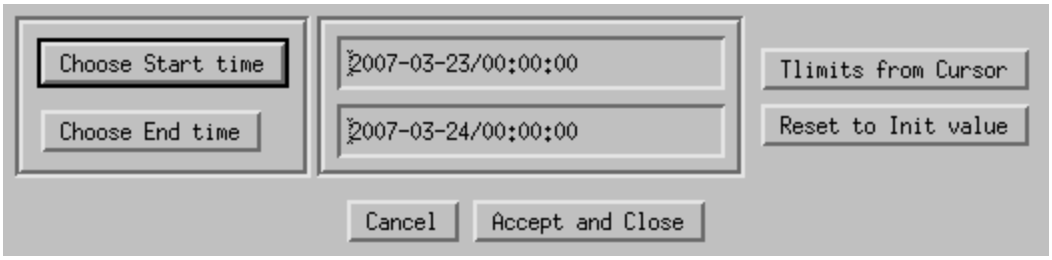
6.3.11 Wavelet Transform

The data is split into components, and a basic wavelet transform is performed on each component, with "_wv" appended to the old variable names. Note that this is designed for data which are either 1-dimensional or 3-dimensional, e.g., electric or magnetic field data. Applying this to other data (e.g., spectrograms) will cause non-intuitive results.

6.3.12 Dpwrspec

The data is split into components, and a dynamic power spectrum is obtained from each component, with "_dpwrspc" appended to the old variable names. Note that this is designed for data which are either 1-dimensional or 3-dimensional, e.g., electric or magnetic field data. Applying this to other data (e.g., spectrograms) will cause non-intuitive results. For some time ranges and data types, the "dpwrspec" button crashes in the IDL POLY_FIT routine. We have no clue why this happens. Try changing the input time range.

6.3.13 Set Time Limits



A popup will appear, allowing the user to set time limits for the processing application, either by using the cursor on the existing plot window, or by using a time selection widget. The “Choose Start time” and “Choose End time” buttons work as in the loading time selection widget, as to the windows for typing in values. The additional buttons work as follows:

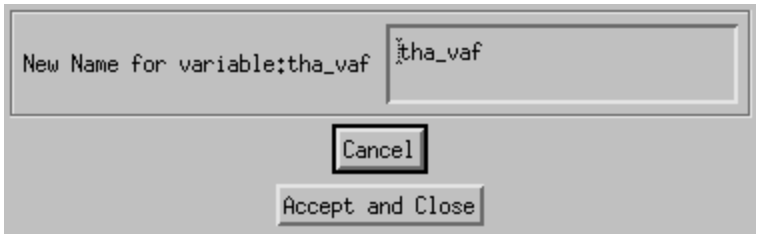
Tlimits from Cursor: Click here move the cursor over the plot window, and click twice on the plot to choose a new time range. You must select a time range by clicking twice on the plot; all other operations on this widget are disabled while you do this.

Reset to Init value: Click here and the time limits will be reset to the initial values in the active data variables.

When you are done, click the "Accept and Close" button to exit the popup. The plot will be reset to the new time limits.

If you click the "Cancel" button, the popup will close, with nothing happening

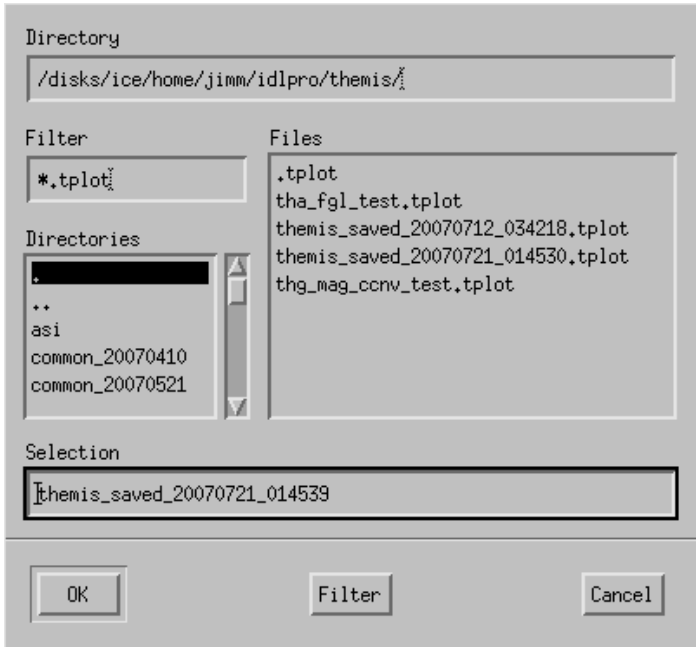
6.3.14 Rename



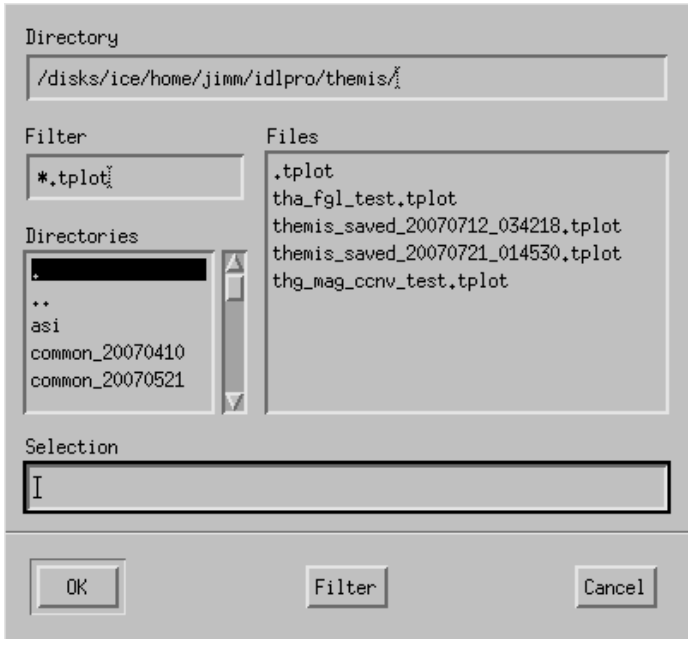
A popup prompts the user for the new variable name for each of the "active" data sets, and each variable is renamed to the new name. Click the “Cancel” button to cancel the operation.

6.3.15 Save

An IDL save file is created with all of the active data sets. A filename selection window is popped up, and the user can change the default filename; “.tplot” is always appended to the selected file. This can be changed, but it is not advised, since the restore routine will look only for those files that end in “.tplot”. Click “Ok” to save. Click the “Cancel” button to cancel the operation.



6.3.16 Restore



Saved files can be restored using this button. A filename selection window will pop up and the user can use this to select a saved file. Click or type the filename, select “Ok” to restore the variables. Click “Cancel” to cancel the operation. The data sets restored from the chosen file are set to be the “Active” data sets.

6.3.17 Save Ascii

The active data sets are saved in ascii files in the current working directory. These cannot be restored, but can be read.

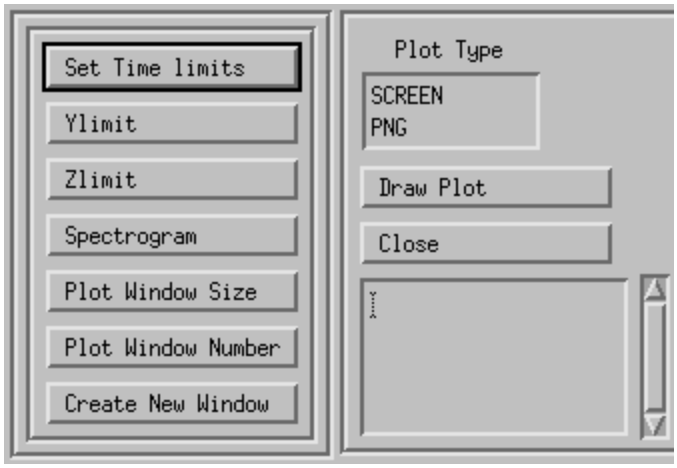
6.3.18 Delete

The active data sets are deleted. To delete all loaded data, type "*" in the window below the Loaded Data window on the main GUI widget, click the "Set Active Data to String" button on the main widget, and then click the delete button on this widget.

6.3.19 Close

Click here to close the widget.

6.4 Plot Menu Widget



When the "Plot Menu" button is first clicked a plot of the active data sets pops up, if there are active data. This is because certain plot parameters have to be initialized for some of the buttons to work properly. If there is no active data, then no plot appears, and nothing will happen if the buttons on this widget are clicked.

6.4.1 Set Time Limits

A popup will appear, allowing the user to set time limits for the processing application, either by using the cursor on the existing plot window, or by typing the limits directly, or using a time selection widget. This is the same as described in section 6.3.13.

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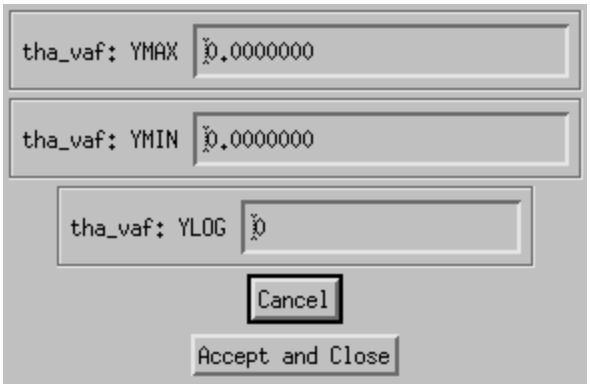
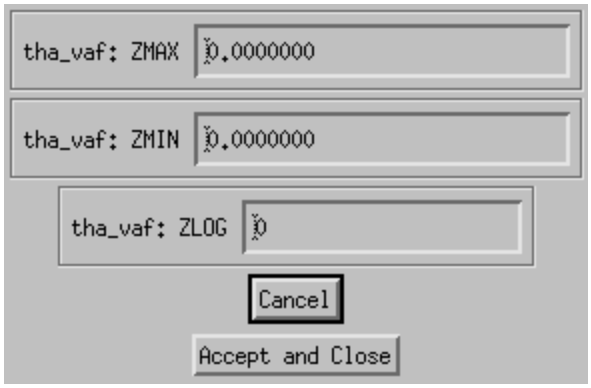
6.4.2 Ylimit



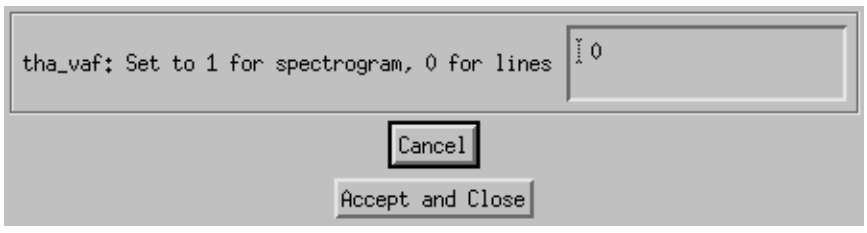
Sets the Y limits for the active data sets. For each active data set, a text widget pops up, allowing the limits to be set, and also log plotting can be set/unset: if ylog is set to 1, then the plot for this variable will be a log plot. If both the maximum and minimum are zero, the plotting process chooses the default limits. Click “Cancel” to cancel the operation.

6.4.3 Zlimit



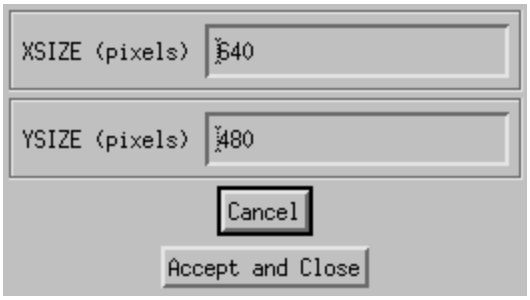
Same as Ylimit, for the Zlimits for spectrogram data.

6.4.4 Spectrogram (Set/Unset)



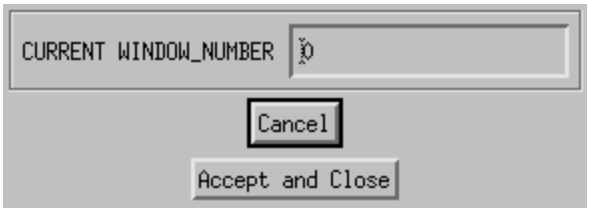
For each active data set, this widget pops up. If this value is set to 1, then the active data is set to be plotted as a spectrogram, if set to 0, then line plots will be drawn. Note that not all data can be characterized as a spectrogram. For those data sets, the pop up will not appear and a message will be issued in the message window for the plot menu, and in the progress window of the main GUI. Click "Cancel" to cancel the operation.

6.4.5 Plot Window Size



Pops up a widget for the window size. For screen plots you can just drag the window for resizing. The set plot window size window can also be used to set the size for png plots. Note that you must set xsize and ysize greater than zero for this to work. Otherwise an error message appears and the window size is not set. It is a good idea not to make windows larger than your screen size. Click "Accept and Close" to close the window and set the window size. Click "Cancel" to cancel the operation.

6.4.6 Plot Window Number



Sets the window number for the screen plots. Only window numbers between 0 and 32 are accepted. The current window number is displayed when the window pops up. Click "Accept and Close" to close the window and set the window size. Click "Cancel" to cancel the operation.

6.4.7 Create New Window

Pops up a plot window with whatever values are currently saved in the widget. The default initial values are 0 for the window number and [xsize,ysize] = [640,480]. This option is not enabled if the plot type is set to 'PNG'.

6.4.8 Plot Type

Click on "SCREEN" for screen plots. Click on "PNG" for png plots.

6.4.9 Draw Plot

Click here to draw the plot. If "SCREEN" is set, then the plot will show up on the screen. If "PNG" is set a png plot will be created when you click the "Draw Plot" button, with a default filename of "thm_gui_plot_yyyymmddss.png" in your local working directory. The time stamp on the file is the local system time. A file selection window pops up to allow you to change the filename.

6.4.10 Close

Click here to dismiss the widget.

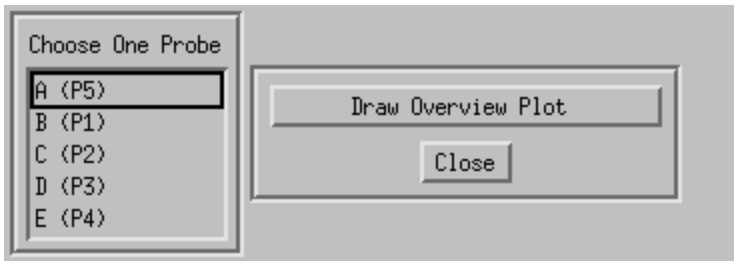
6.4.11 Message Window

In addition to alerting the user when a process crashes, this message window will alert the user when an invalid input parameter is set for the processes. The text is the same as in the progress window of the main GUI. For user input errors, the THEMIS Error widget does not pop up.

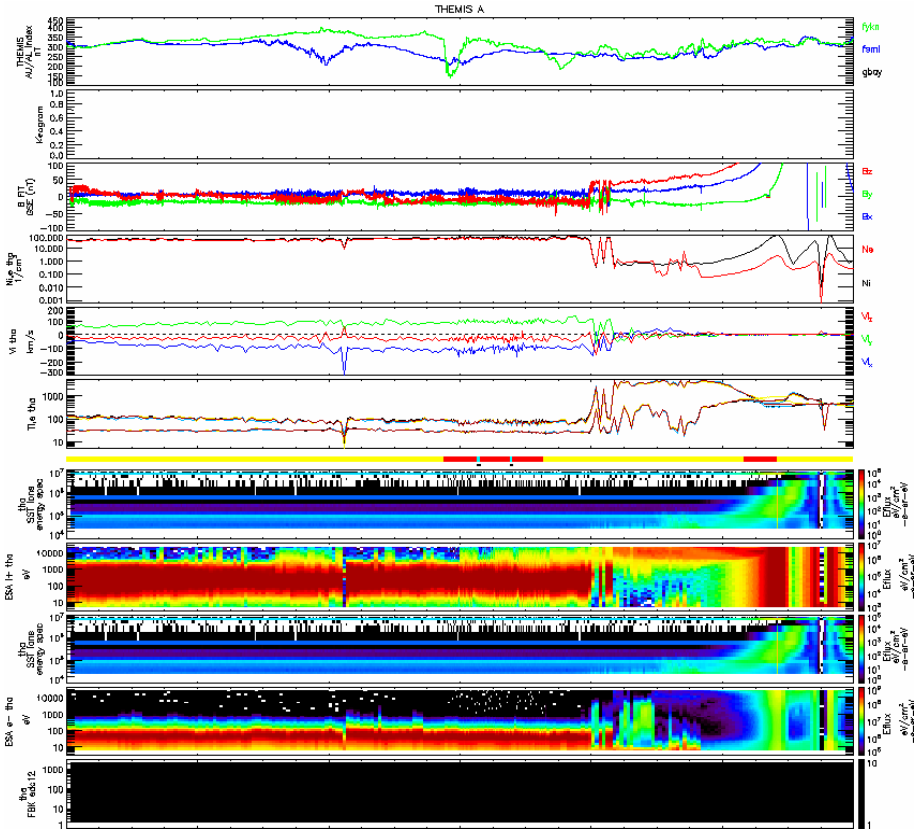
6.5 Plot Data (Main GUI widget)

There is also a “Draw Plot” button on the main GUI widget. This has exactly the same effect as the “Draw Plot” button on the Plot Menu widget: If "SCREEN" is set, then the plot will show up on the screen. If "PNG" is set a png plot will be created when you click the "Draw Plot" button, with a default filename of "thm_gui_plot_yyyymmddss.png" in your local working directory. The time stamp on the file is the local system time. A file selection window pops up to allow you to change the filename.

6.6 Overview Plot



Clicking on this button pops up a widget that will do an overview plot of various THEMIS data. On the overview plot widget, there is a widget that allows you to choose a probe. Only one probe is allowed at a time. The "Draw Overview plot" button pops up a plot that shows a broad view of THEMIS data. The data sets that are plotted are set to be the active data sets. Here is a sample plot:



6.7 GUI Tips

a. Remember to save and email your history file if you have a bug. Also feel free to include any other output messages that show up in the IDL command line.
b. Always choose a time range before loading data.
c. Don't load more than a couple of days at a time, or a couple of hours if you are loading full resolution all-sky imager (asf) data.
d. The choice of "probe" in the data loading widgets is global, that is, all of the selected data will be loaded for the probe(s) chosen most recently. If, for example, you want to load EFI data from probe "A" and FGM data from probe "B", you will need to load these separately. When choosing multiple probes, data types, or whatever, hold the "control" key, and click more than one. Also, you can click on an option, then hold "shift" and the left mouse button, and drag the cursor over the others.
e. The data names are kind of cryptic, there is a table in the User's Guide and also at the end of the text in the help widget for guidance.
f. Once you've chosen data, hit the "Clear Load Queue" to clear it out if you don't want to load it. If a load fails (for a reason other than "the data isn't there"), then the data are still waiting to be loaded. Clear the load queue.
g. Remember that all loaded data are set to "active" immediately upon loading. If you don't want all of that data to be active, then click on what you want in the Loaded Data window.
h. If you want to delete all data, type "*" window below the Loaded Data window, click "Set Active Data to String", call up the Data Processing widget, and click "Delete".
i. For coordinate transforms, data that have "Unknown" for a coordinate system will not be transformed. Multiple data sets with different input coordinates *can* be transformed.
j. Data Processing and Plotting tasks are only possible when there is "active" data.
k. When typing in strings for numerical input -- be careful. Strings that aren't numbers are interpreted as 0 by IDL, but strings that aren't numbers, but start with a number are set to the number, e.g., 'a14' is set to 0, but '1a4' is set to 1. When in doubt, look in the History.
l. Sometimes data is inappropriate for a given operation (especially wavelet transforms, and power spectra). We have tried to catch as many of these situations as we can, but there probably will be more as more types of data are imported. If something looks weird, save your history, and email us.
m. For some time ranges and data types, the "dpwrspec" button crashes in the IDL POLY_FIT routine. We have no idea why this happens, but are working on a fix. Try changing the input time range to a longer range, and see if that helps.
n. Some processes can take a while (e.g., calibrating SCM data, wavelet transforms of whole days). Currently there is no good way to stop a process except for the standard IDL "control-C" on the IDL window. This doesn't always work.
o. The Plot Data button first issues a "tplot" call when the widget pops up.
p. If you create a "PNG" plot, remember to reset to "SCREEN" for screen plotting.
q. Don't try to plot more than about 10 quantities at a time, if there is spectrogram data, there will be a crash.