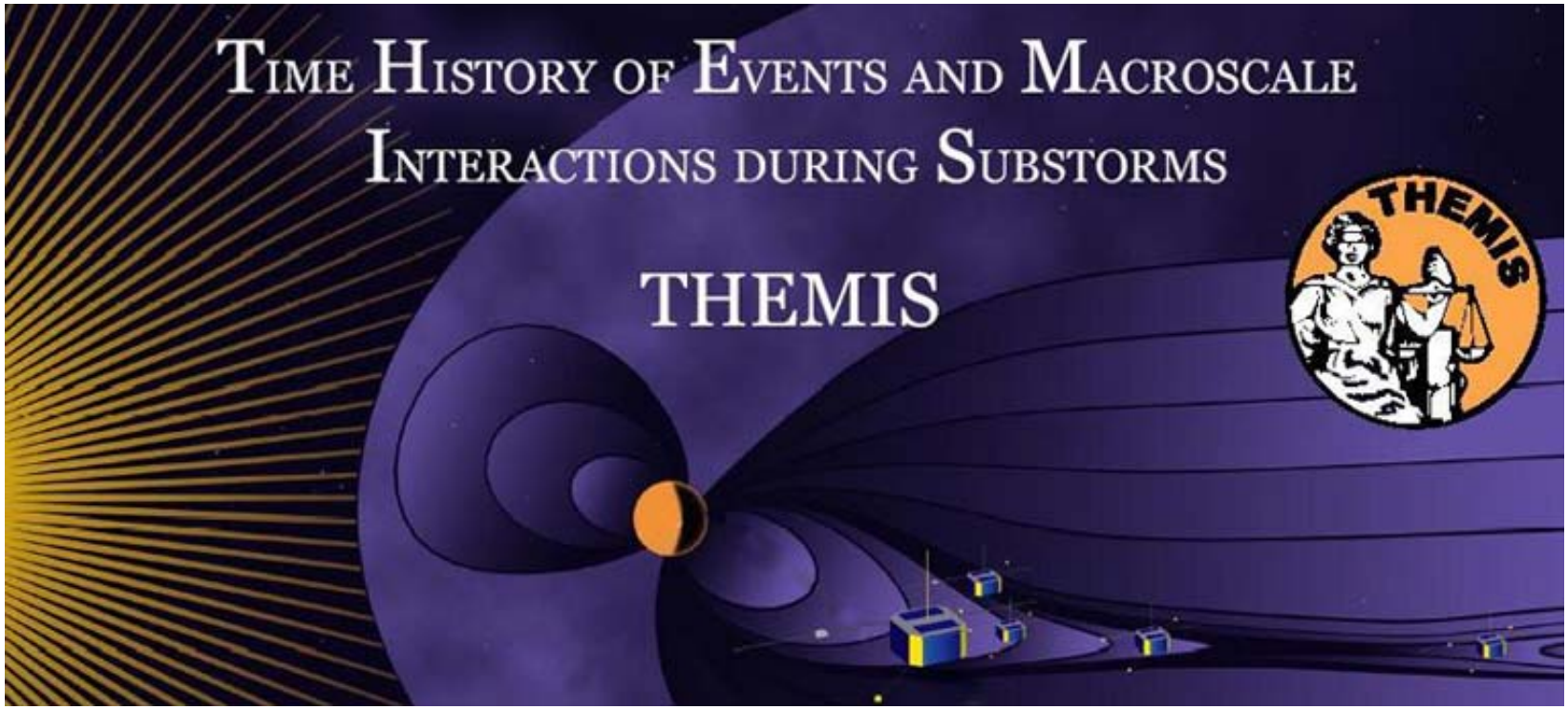


Science Software – v4.00 Training

GEM Mini-Workshop

June 26, 2008

Agenda

02:00	Introduction	V. Angelopoulos
02:10	THEMIS Web Site	D. King
02:20	V4.00 Science Software/Data Status Report	V. Angelopoulos
02:30	THEMIS Science Data Analysis Software	J. McTiernan / Pat Cruce
03:00	THEMIS Graphical User Interface (GUI)	D. King / J. McTiernan
03:15	THEMIS Ground Based Observatories (GBO)	J. McTiernan
03:30	Q&A's	All
03:45	Software Clinic	All

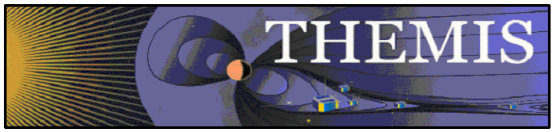
Status Report

V4.00 Science Software/Data Status Report

- General
  - Loads, introduces and calibrates all L1 quantities, all instruments
  - Loads calibrated L2 quantities
- FGM
  - L1, L2 data available since early March 2007
- SCM
  - L1 data available since early March 2007
  - L2 frequency spectrograms (FBK) available now
- EFI
  - All L1 data available from TH-C since May 2007, TH-D,E since Jun 7
- ESA
  - No L1 data, only L0 data – however, read-in is transparent to user
  - All data available since ESA turn-on, i.e., mid-March
  - L2 omnidirectional energy spectrograms, ground moments available no
- SST
  - L1 data available since SST turn-on, mid-March
  - L2 omnidirectional energy spectrograms available now

THEMIS Data Analysis Software

Organization	Contributors
UC Berkeley	D Larson, H Frey, J Bonnell, J McFadden, A Keiling
	J McTiernan, J Lewis, D King
UCLA	V Angelopoulos, P Cruce, B Kerr, C Goethel, M Feuerstein,
	K Ramer, H Schwarzl
SP Systems	K Bromund
NASA/GSFC	V Kondratovich
MPE	E Georgescu
TUBS	U Auster
CETP	P Robert, O LeContel
Calgary	B Jackel, E Donovan



Overview

Overview

- Software Objectives
  - Powerful, Flexible Command Line Interface
  - GUI to provide Easy Access to Key Features
- Software Installation
- Data Distribution
- Key Routines, crib sheets.
- Examples

Software Objectives

- Code is available to everyone, but not required to analyze data.
- IDL based (library of routines –but no main program!).
- Separates the tasks of:
  - Reading files.
  - Manipulating data
  - Plotting
- Platform independent. Works on:
  - Solaris
  - Linux
  - Windows
  - Mac OS X
- Self-Documenting
  - Auto-generated html help: idl/_tdas_doc.html
  - `IDL> DOC_LIBRARY, 'routine_name'`

Software Design

THEMIS-specific routines (idl/themis)

- Instrument-specific routines organized according to ground/spacecraft/state, fields/particles, instrument name.
  - Loading data
  - Calibrating data
- Transforming data
- Examples – crib sheets
- GUI – built on top of the command-line routines

General routines (idl/ssl_general)

- Library of generic routines useful for building mission-specific load routines
  - CDF reading/writing routines
  - File retrieval routines
  - Miscellaneous routines
- Plotting routines
  - Uses “tplot variables”: strings that associate data together with metadata and plotting parameters.
  - Routines to manipulate/plot tplot variables
- Data Export routines
- Data Processing routines

External Libraries (idl/external)

- CDAWlib – from NASA SPDF, reads/plots CDF data
- IDL_GEOPACK – Magnetic field modelling kit

System Requirements

Windows, Solaris, LINUX, PPC Mac or Intel Mac.

IDL 6.2 or higher required

IDL Patch Recommended

- http://cdf.gsfc.nasa.gov/html/cdf_patch_for_idl6x_new.html
- Required for IDL 6.2, (Strongly recommended for IDL 6.4 and 7.0)
- Required for Intel Mac, regardless of IDL version

For Mac, system configurations are required to run IDL

- X11 – may need to be installed.
- mouse click-through
  - one-time X11 configuration necessary for proper operation:

```
defaults write com.apple.x11 wm_click_through -bool true
```

See THEMIS User's Guide for full information, available at:
ftp://apollo.ssl.berkeley.edu/pub/THEMIS/

Installing/Configuring TDAS

For a new installation:

- Download and expand the latest TDAS release .zip file. The latest version is 4.00. http://themis.ssl.berkeley.edu/socware/tdas_4_00/tdas_4_00.zip
- Create a directory called TDAS into which you will copy the latest software.
- Move the tdas_x_xx folder into the TDAS directory you created.
- Configure IDL to search the TDAS directory for IDL programs. Details on next slide.

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

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

Path Setup

Set up the IDL path

- Windows and IDLDE on any platform:
  File->Preferences
  Path Tab
  Press Insert
  Browse to find the TDAS folder you created.
  Check the box preceding the path to 'search subdirectories'

- UNIX-like systems (Mac OS X, Linux, Solaris)

```
In .cshrc:
setenv IDL_PATH '<IDL_DEFAULT>:+/path/to/tdas'
 -Or-
In .bashrc or .bash_profile:
export IDL_PATH='<IDL_DEFAULT>:+/path/to/tdas'
```

Path to Data Directory

- Data directory will be created automatically at
  - C:/data/themis (Windows)
  - ~/data/themis (UNIX/LINUX/Max OS X)
- Run thm_ui_config from command line or THEMIS GUI if you need to change this.

Data Definitions

The software operates on Level 1 and Level 2 data.

Data Level Definitions:

Level 0 Data –

- Raw files (*.pkt) one per APID.
- Only used for loading ESA data.

Level 1 Data -

- CDF (Common Data Files) files (*.cdf)
- Files contain raw, uncalibrated data. i.e. counts, DAC units.
- Requires TDAS software to interpret. Calibration is done by default when Level 1 data is input.

Level 2 Data -

- CDF files – contain physical quantities – TDAS software is not needed for interpretation.
- Files available for ESA, FBK, FIT, FGM, MOM, SST – can be downloaded from SPDF.

Data / Directory structure

- Data Directory structure is large!
  - Scores of files per day
  - ~3GB/day for all probes (L1 data)
- Directory hierarchy keeps directory sizes manageable
  - Software performs automatic file retrieval.
  - Software maintains directory hierarchy.
- Behavior of Automatic File Retrieval is configurable
  - ‘No Download’ mode for stand-alone operation.
  - ‘No Update’ mode to preserve local modifications.
  - Root directory of local copy of hierarchy is determined automatically, but configurable.
  - Available configuration methods:
    - thm_ui_config IDL widget
    - 'Config' button in the thm_gui IDL widget.
    - Environment variables

Primary Routines

Load Routine Summary

Name	Description	L0	L1		L2
			raw	calibrated	
thm_load_asi	All-Sky Imager.		*	-	
thm_load_ask	All Sky Keogram		*	-	
thm_load_efi	Electric Fields Instrument waveforms		*	(*)	
thm_load_esa	ElectroStatic Analyzer				*
thm_load_esa_pkt	ElectroStatic Analyzer	*			
thm_load_fbk	Fields Filter Bank		*	*	*
thm_load_fft	On-board Fields Fast Fourier Transform.		*	*	
thm_load_fgm	Flux Gate Magnetometer waveforms		*	*	*
thm_load_fit	On-Board Fields Spin-Fit		*	*	-
thm_load_gmag	Ground Magnetometer				*
thm_load_hsk	Housekeeping		*		
thm_load_mom	On-board Particle Moments		*	(*)	
thm_load_scm	Search Coil Magnetometer waveform		*	(*)	
thm_load_sst	Solid State Telescope		*	-	*
thm_load_state	Orbit and Attitude		v2		

Notes:
(*) calibration routine available but still under development
- data reduction and analysis routines available: see crib sheet

Primary Routines

Usage Conventions:

Use keywords to determine functionality

level - Calibrated Level 1 data is the default (Except for SST and ESA data, which is handled differently).

datatype and probe keywords determine which data is loaded and/or created through calibration process

/get_support_data keyword is needed in thm_load_state to load data required by thm_cal* and thm_cotrans routines.

To load uncalibrated data, set type = ‘raw’ (For all but SST, ESA)

Example from IDL Command Line:

```
timespan,’2007-07-07’,1    ;choose a time range
thm_load_state, probe = 'a', /get_support_data
thm_load_fgm, probe='a', coord='gsm', datatype='fgl', level=1
```

Variable Names

Probe specification. Example: tha
- a – can be one of [a-e] specifies probe

Particle data. Example: tha_peif
- p – particles
- e – ESA, s – SST
- i – ions, e – electrons
- f – full, r – reduced, m – moments, b – burst

FGM data. Example: tha_fgl
- l – low telemetry rate, h – high telemetry rate, e – engineering decimated high rate, s – spin fit.

Electric Fields and SCM. Example: tha_efs
- ef - efi, sc – scm, fb – fbk, ff – fft
- s – spin fit, f – full orbit or fast survey, p – particle burst, w – waves burst.

Wildcards are accepted in names when plotting and data processing:
- th?_fg?
- th[ab]_fg[lh]
- th?_state*

Crib Sheets for Loading, Processing and Plotting

thm_crib_asi
thm_crib_dproc
thm_crib_efi
thm_crib_esa_da
thm_crib_esa_moments
thm_crib_export
thm_crib_fac
thm_crib_fbk
thm_crib_fft
thm_crib_fgm
thm_crib_fit
thm_crib_gmag
thm_crib_mom
thm_crib_mva
thm_crib_overplot
thm_crib_part_getspec
thm_crib_scm
thm_crib_sst
thm_crib_state
thm_crib_tplot
thm_crib_tplotxy
thm_crib_twavpol
thm_map_examples

IDL>.run thm_crib_asi

or cut and paste, or copy and modify

Coordinate Transformations

Coordinate Transformations

- thm_cotrans
  - transforms to/from any of the following coordinate systems in a single call
  - updates metadata in output.
  - knows coordinate system of input from metadata
- Currently Supported Geophysical Coordinate Systems
  - 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
  - SM Solar Magnetic
  - GEO Geographic Coordinate System
- Example
  - thm_load_state, /get_support_data
  - thm_cotrans, 'th?_fg?', out_coord='geo‘, ouf_suffix = ‘geo’

Plotting & Analysis Routines

Plotting

- tplot
- tplotxy
- plotxy
- plotxyz
- tplot_names
- tlimit
- get_data
- store_data

Example:

```
tt89,'thc_state_pos',newname='model_field'
fac_matrix_make,'model_field' ,other_dim=
 'xgse', newname = 'fac_mat'
tvector_rotate, 'fac_mat', 'thc_peir_velocity',
 newname = 'ion_velocity_model_fa'
```

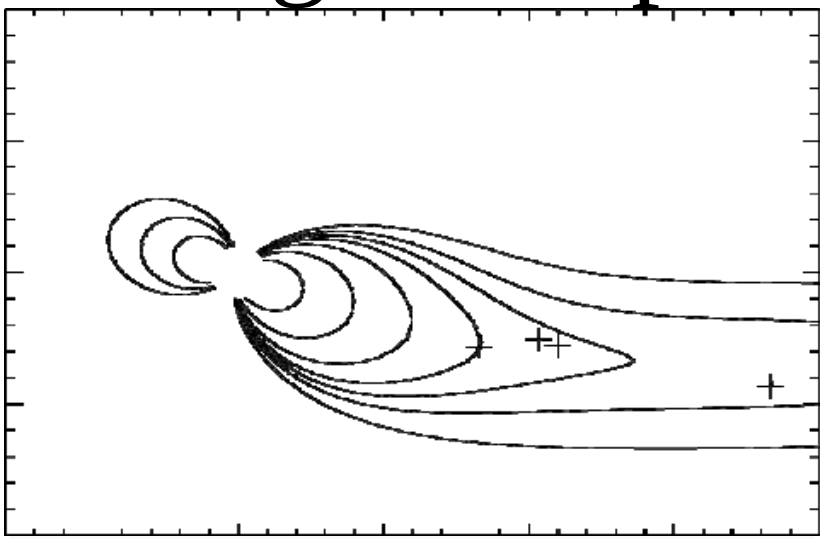
Analytic Coordinate Transformations

- tvector_rotate
- fac_matrix_make
- thm_fac_matrix_make
- minvar_matrix_make

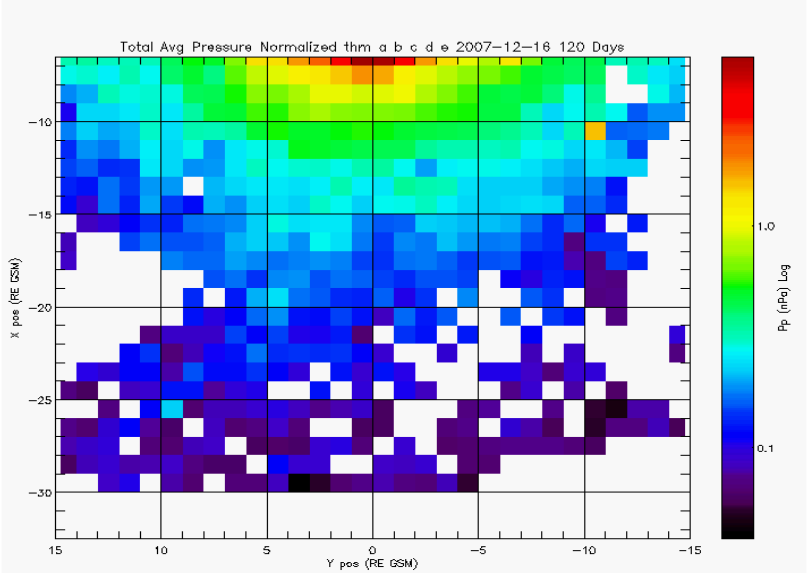
Tsyganenko Model

- (t)trace2iono
- (t)trace2equator
- (t)t89
- (t)t96
- (t)t01
- (t)t04s

Plotting Examples

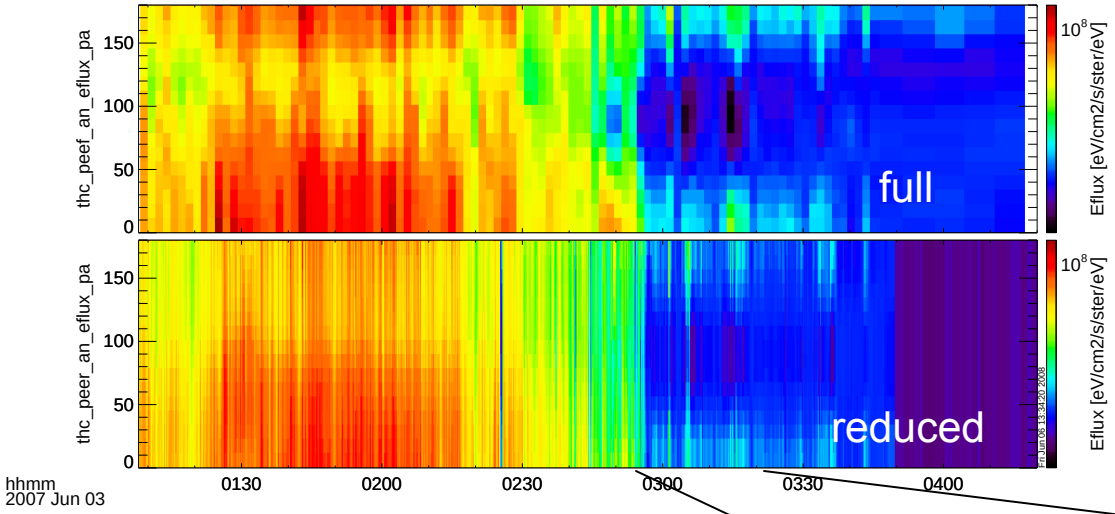


tplotxy can be used to plot isotropic position plots. Like plots of magnetic field models and spacecraft position



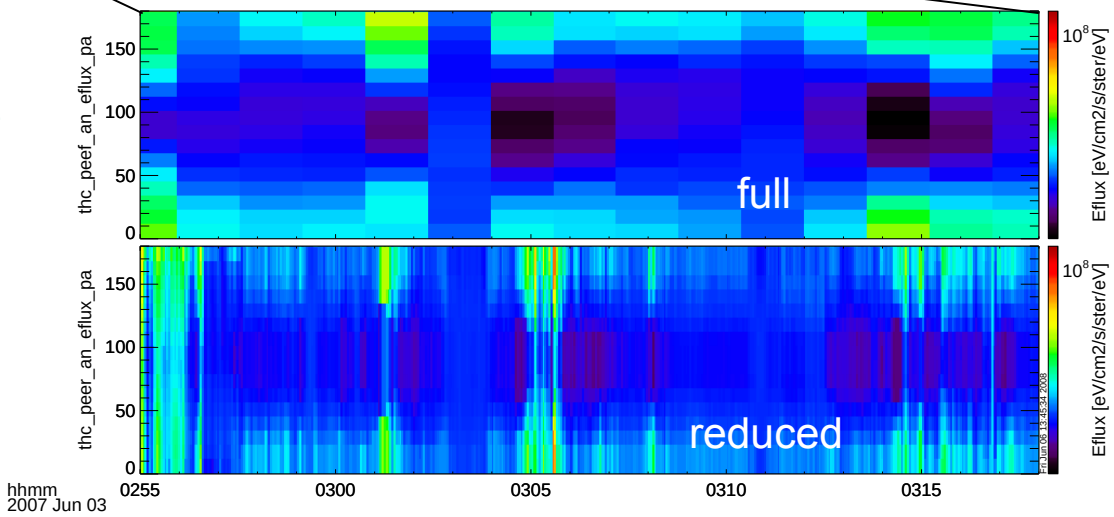
Plotxyz can be used to plot 3 dimensional isotropic data, with any axis.(Not restricted to time-series.)

Plotting Angular Spectra



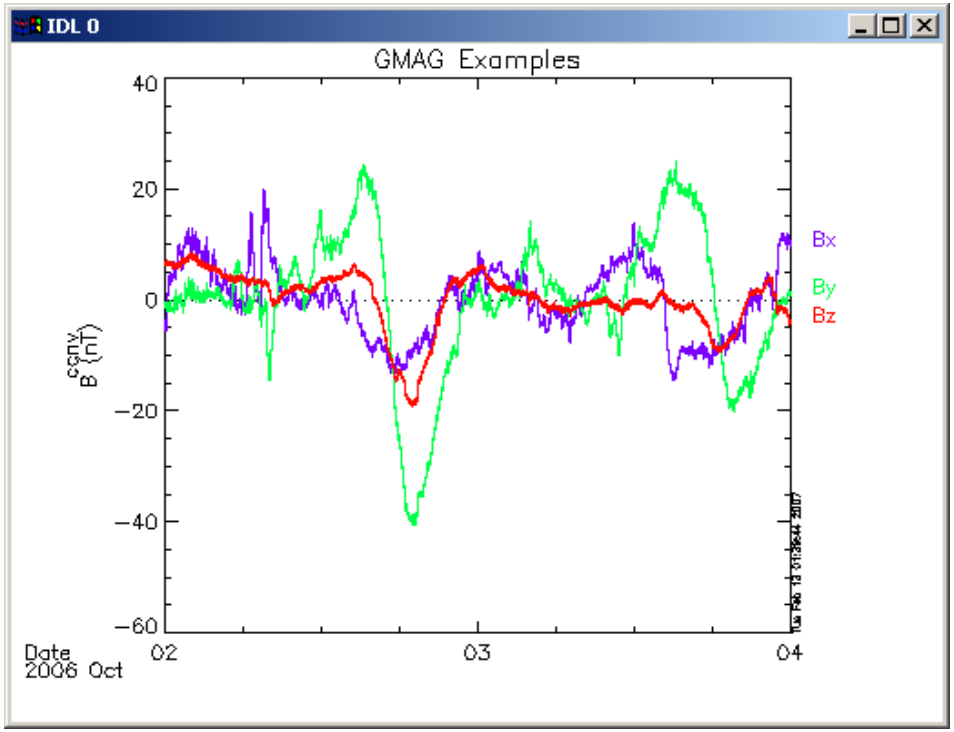
Pitch angle spectra for full and reduced mode electron ESA data. Plotted using tplot.

```
thm_part_getspec, $
probe=['c'], $ ;select probe
trange=['07-06-03/01:08', $  ;select timerange
        '07-06-03/04:20'], $
data_type=['peef','peer'], $ ;select data type
angle='pa', $ ;select pitch angle spectra
regrid=[32,16] ;set resolution of pitch/gyro
spectra
```



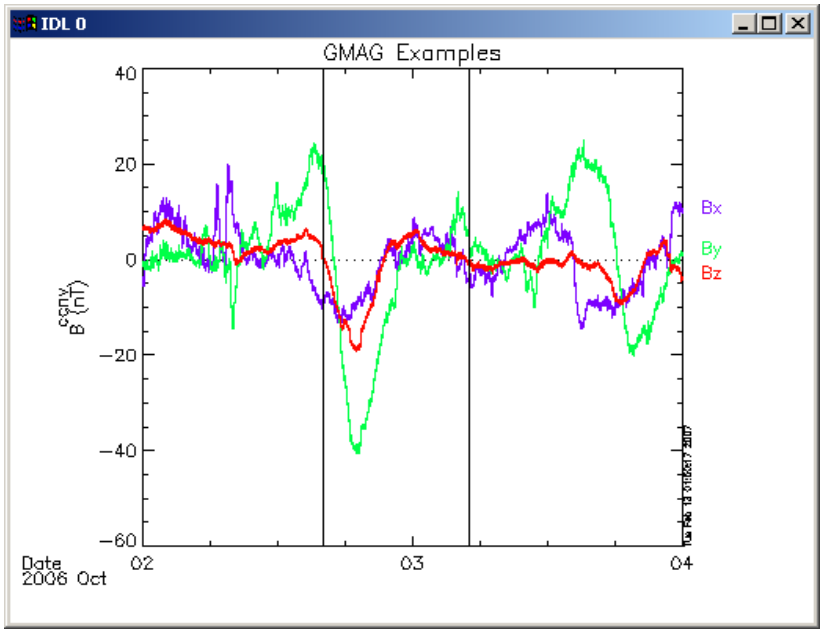
Command Line Example 1

- To load data:
  - » timespan,'6-10-2',2,/days
  - » thm_load_gmag,site='ccnv',$ /subtract_average
- To plot data:
  - » options,'thg_mag_ccnv',$ labels=['Bx','By','Bz']
  - » tplot_options, 'title', $ 'GMAG Examples'
  - » tplot,'thg_mag_ccnv'

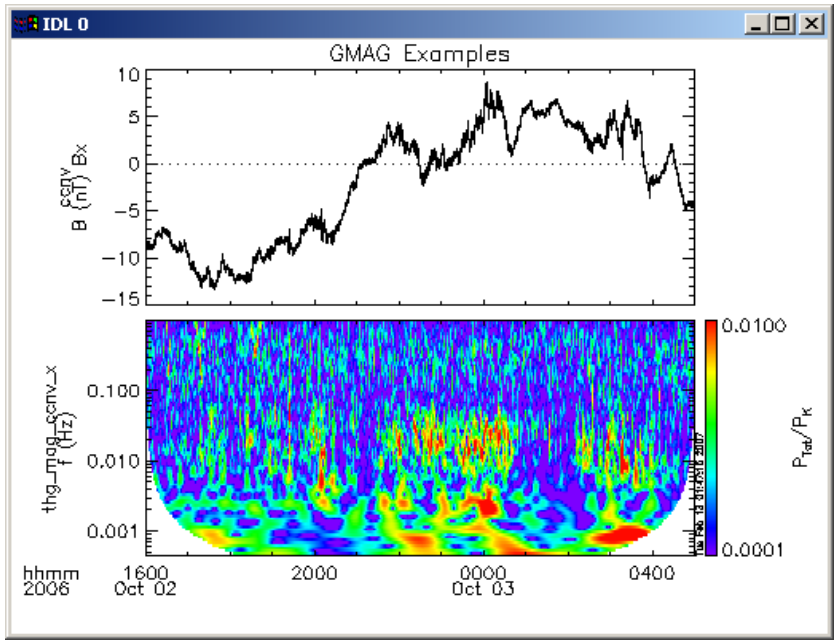


Command Line Example 2

- Wavelet transform on an interval of interest
  - Define and display the interval
    - » Tr = ['2006-10-2/16:00','2006-10-3/05']
    - » timebar,tr



- Split the 3-vector into components:
  - » split_vec,'thg_mag_ccnv'
- Compute transform of one component
  - » wav_data,'thg_mag_ccnv_x',/kol $,trange=tr ,maxpoints=24l*3600*2
- Set color limits (log scale)
  - » zlim,'*pow', .0001,.01,1
- Plot it.
  - » tplot,'*ccnv_x*',trange=tr



Graphical User Interface

Called from IDL command line (thm_gui).

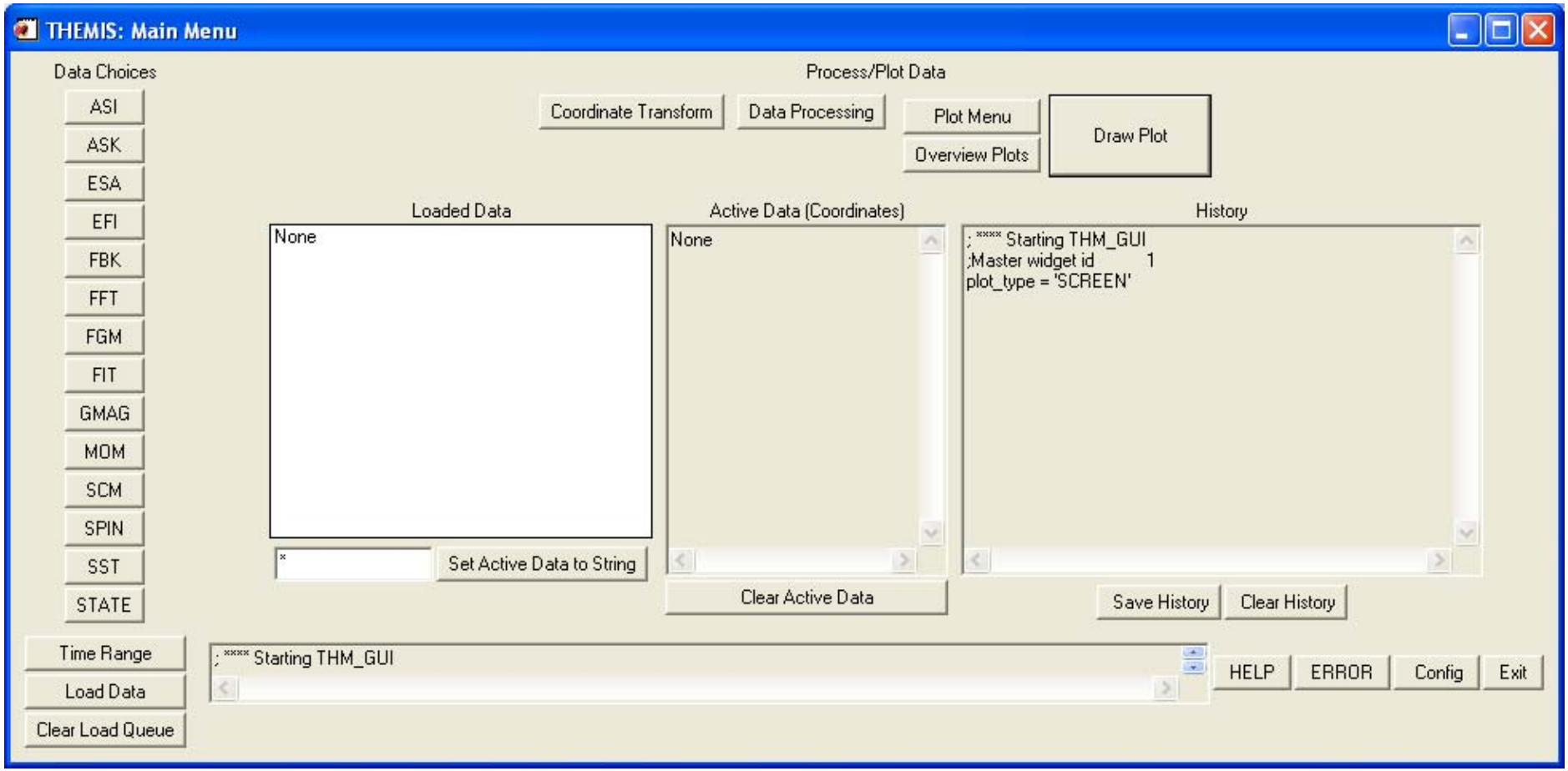
```
IDL> thm_gui
```

Gives the ability to load, calibrate, coordinate transformations, data manipulations and plot data.

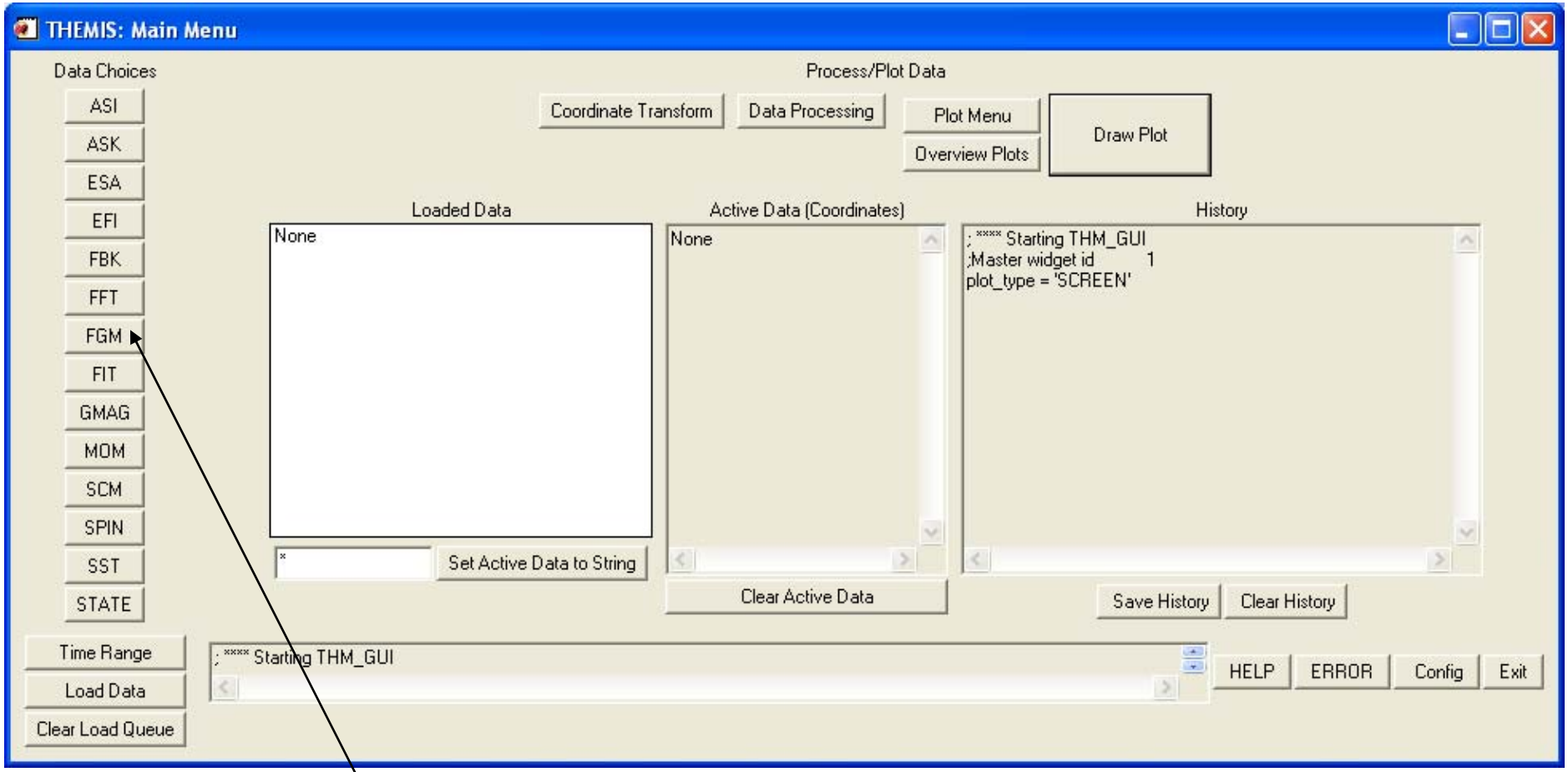
Calls various TPLOT routines

IDL functions are available from the command line when the main window is being displayed as well.

Main Menu:

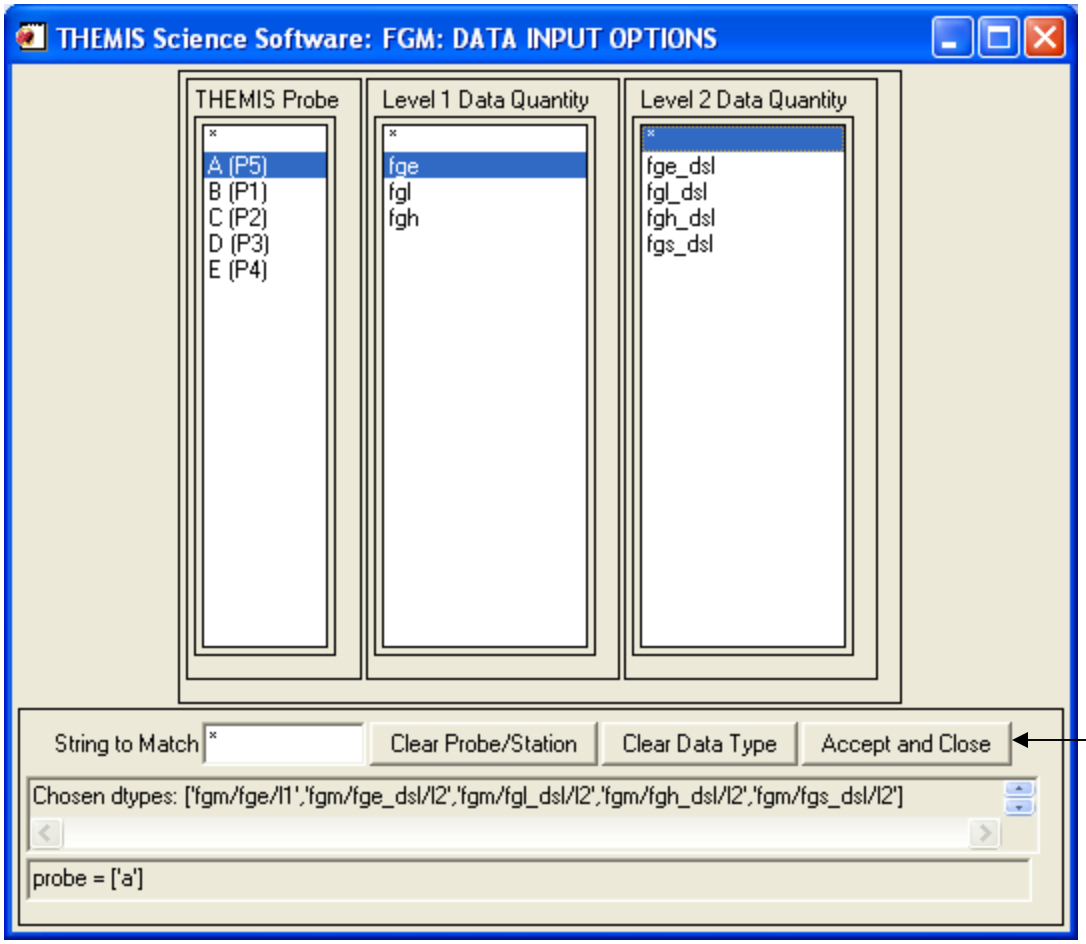

THEMIS: Main Menu
Data Choices
ASI
ASK
ESA
EFI
FBK
FFT
FGM
FIT
GMAG
MOM
SCM
SPIN
SST
STATE
Process/Plot Data
Coordinate Transform
Data Processing
Plot Menu
Overview Plots
Draw Plot
Loaded Data
None
Active Data (Coordinates)
None
History
; ***** Starting THM_GUI
;Master widget id 1
plot_type = 'SCREEN'
*
Set Active Data to String
Clear Active Data
Save History
Clear History
Time Range
Load Data
Clear Load Queue
; ***** Starting THM_GUI
HELP
ERROR
Config
Exit

Choose Data to Load:



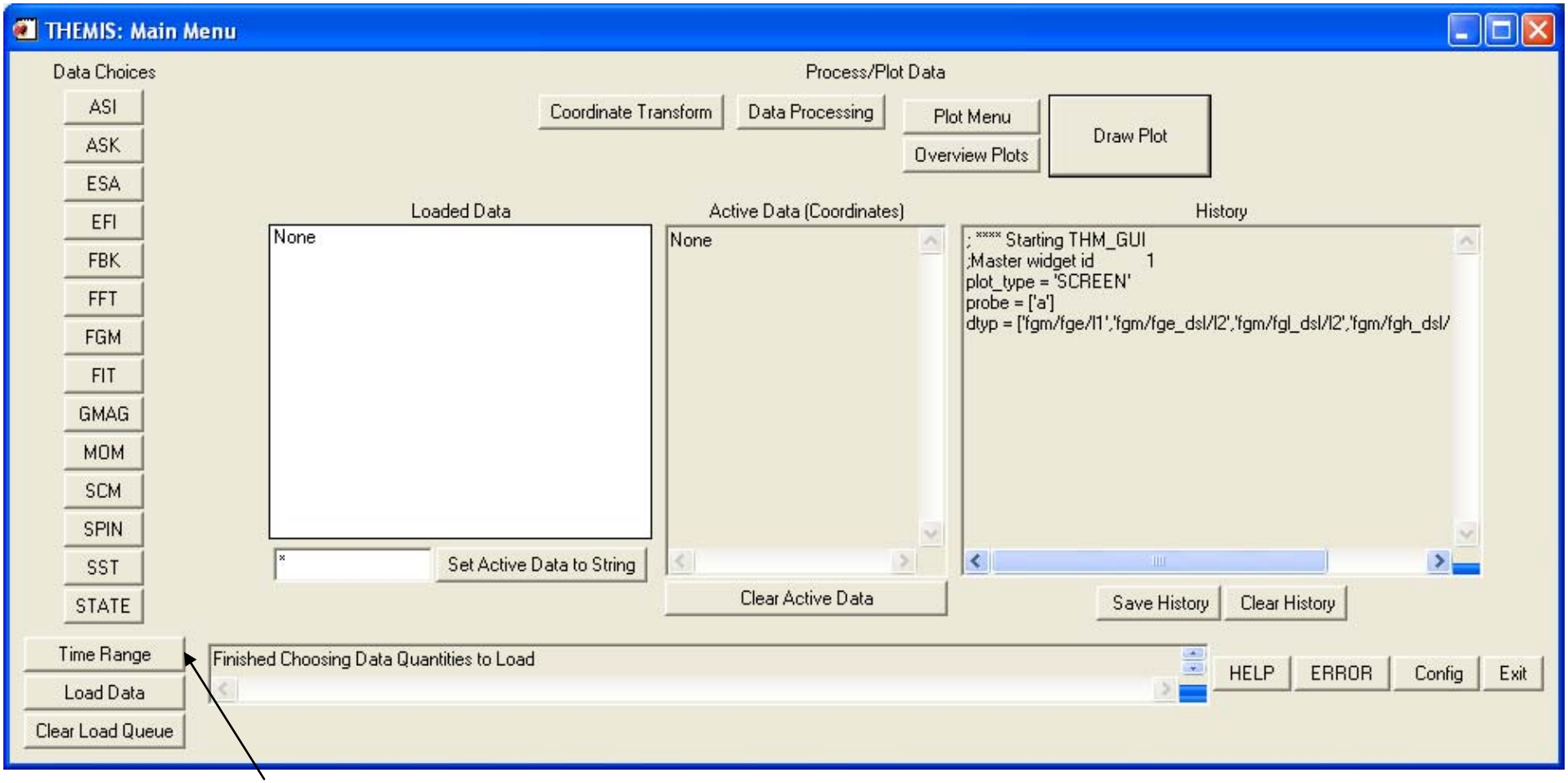
Click here for FGM data

Selecting Data:



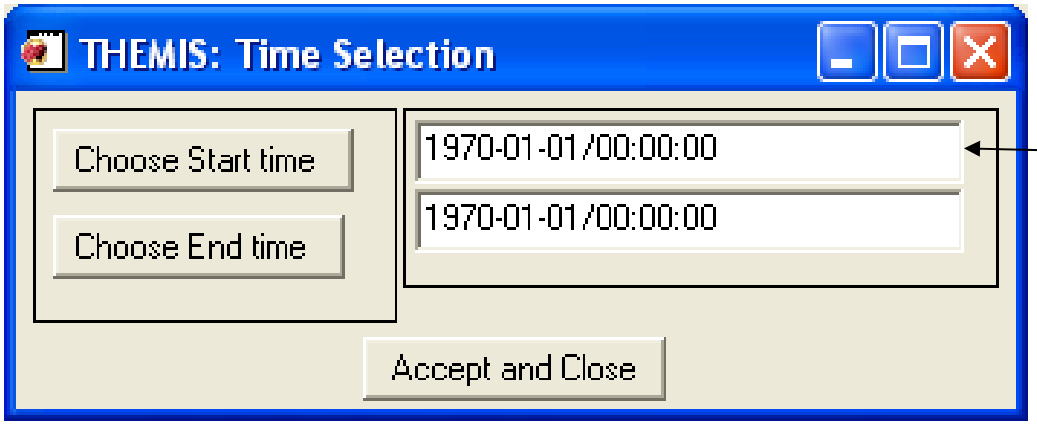
Nothing will happen until you click here

Choose a Time Range:



Click here to choose times.

Time Selection: Entering start time

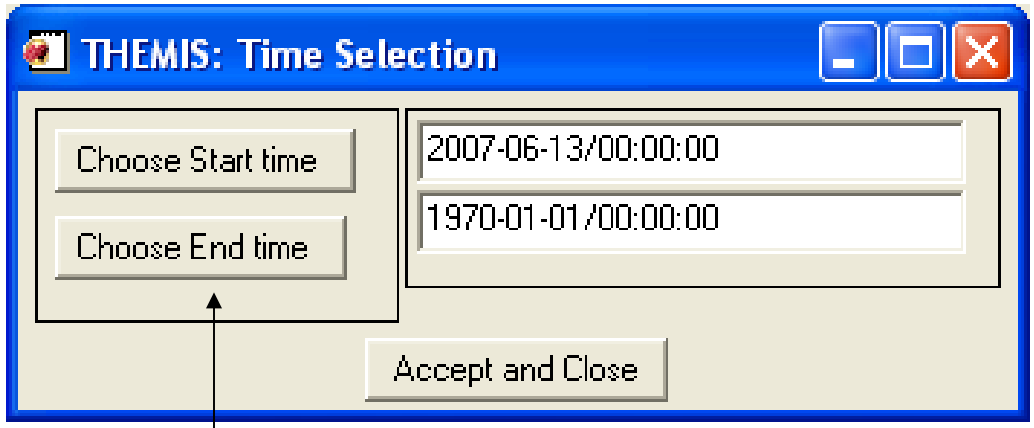


You can type here.

For example: 2007-06-13

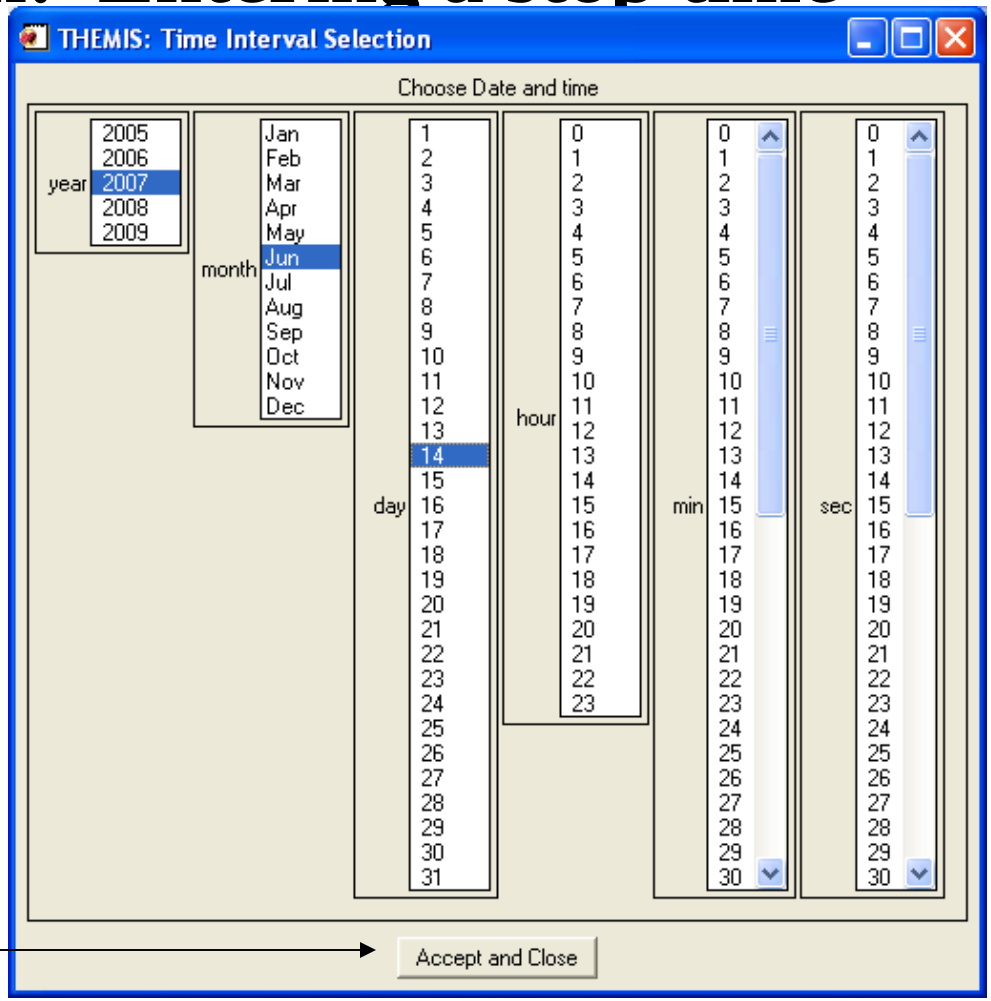
Initially times are set to 1970-01-01/00:00:00
Times show up in history window as you type.

Time Selection:



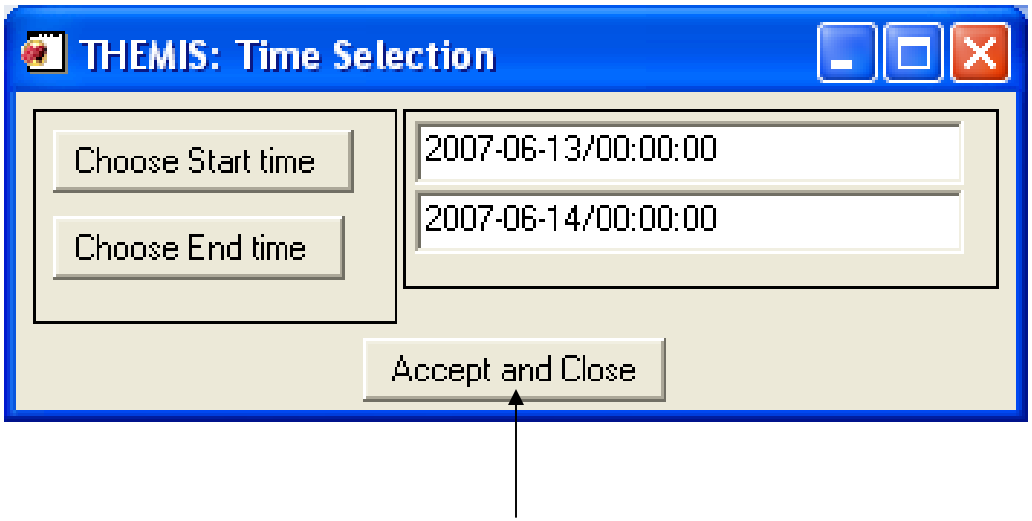
Click here for a time selection window

Time Selection: Entering a stop time



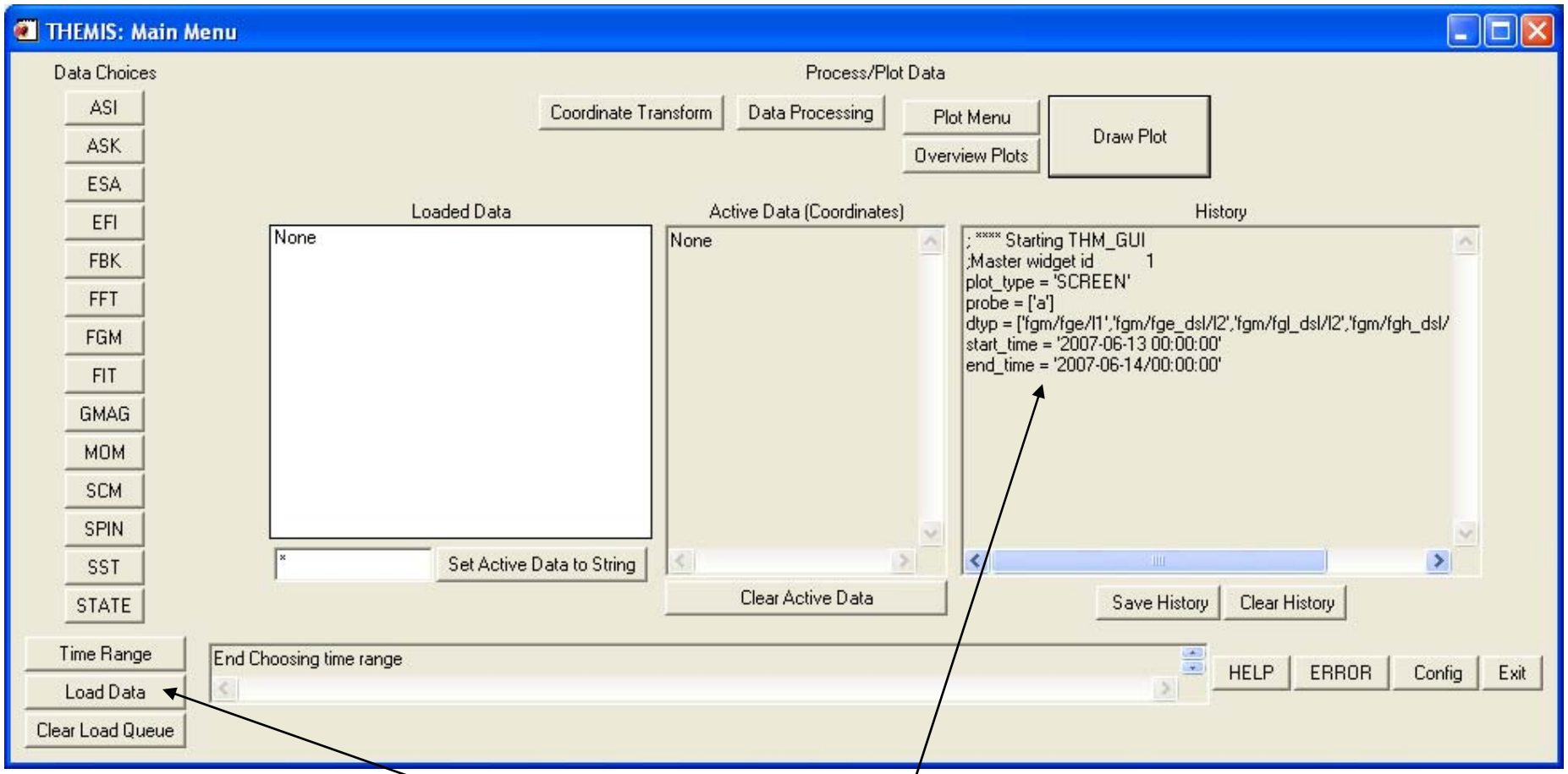
Click here to accept selected time and close window

Time Selection:



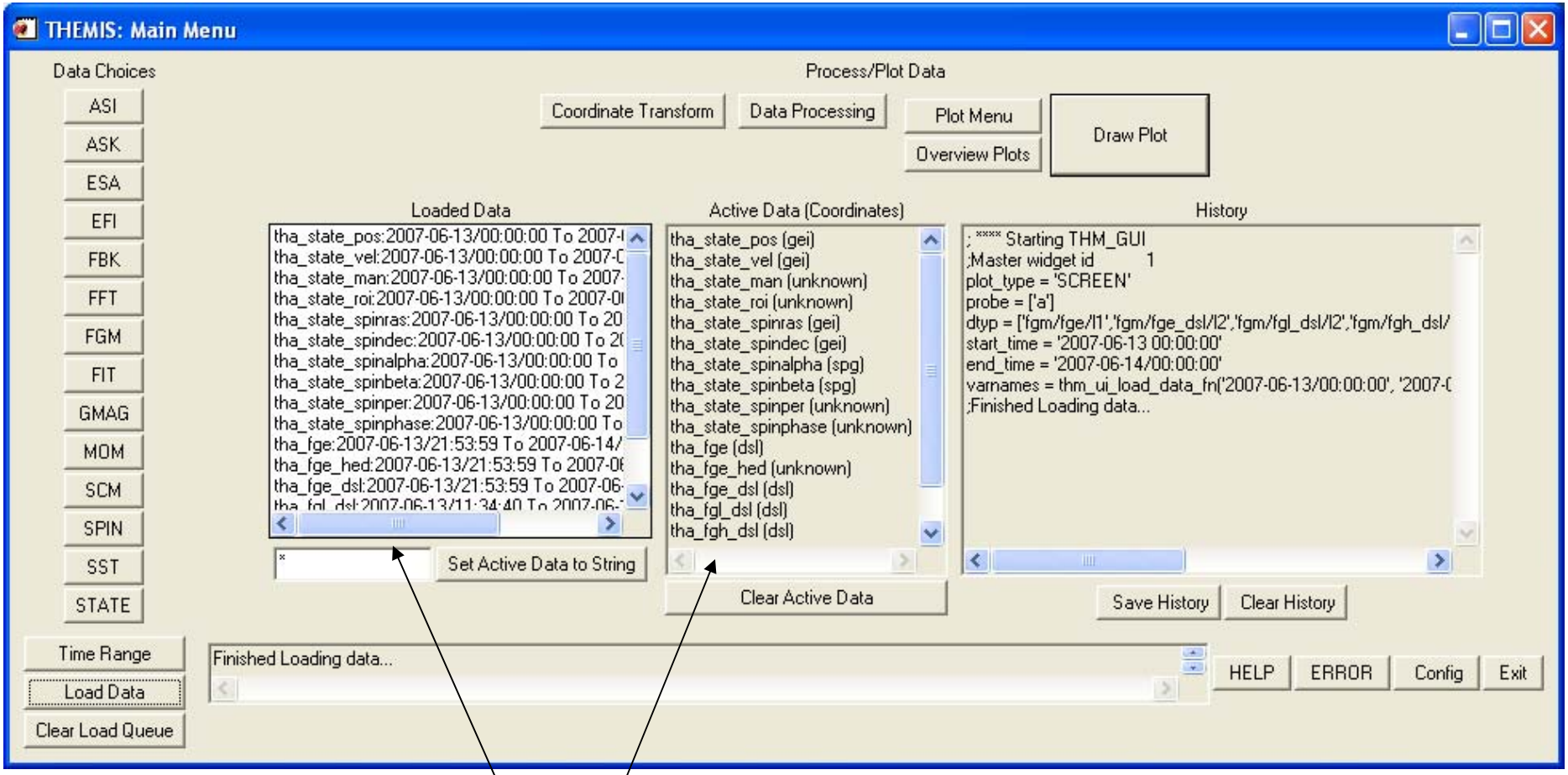
Click here to accept time range and close window

Selection Displayed in History Window:



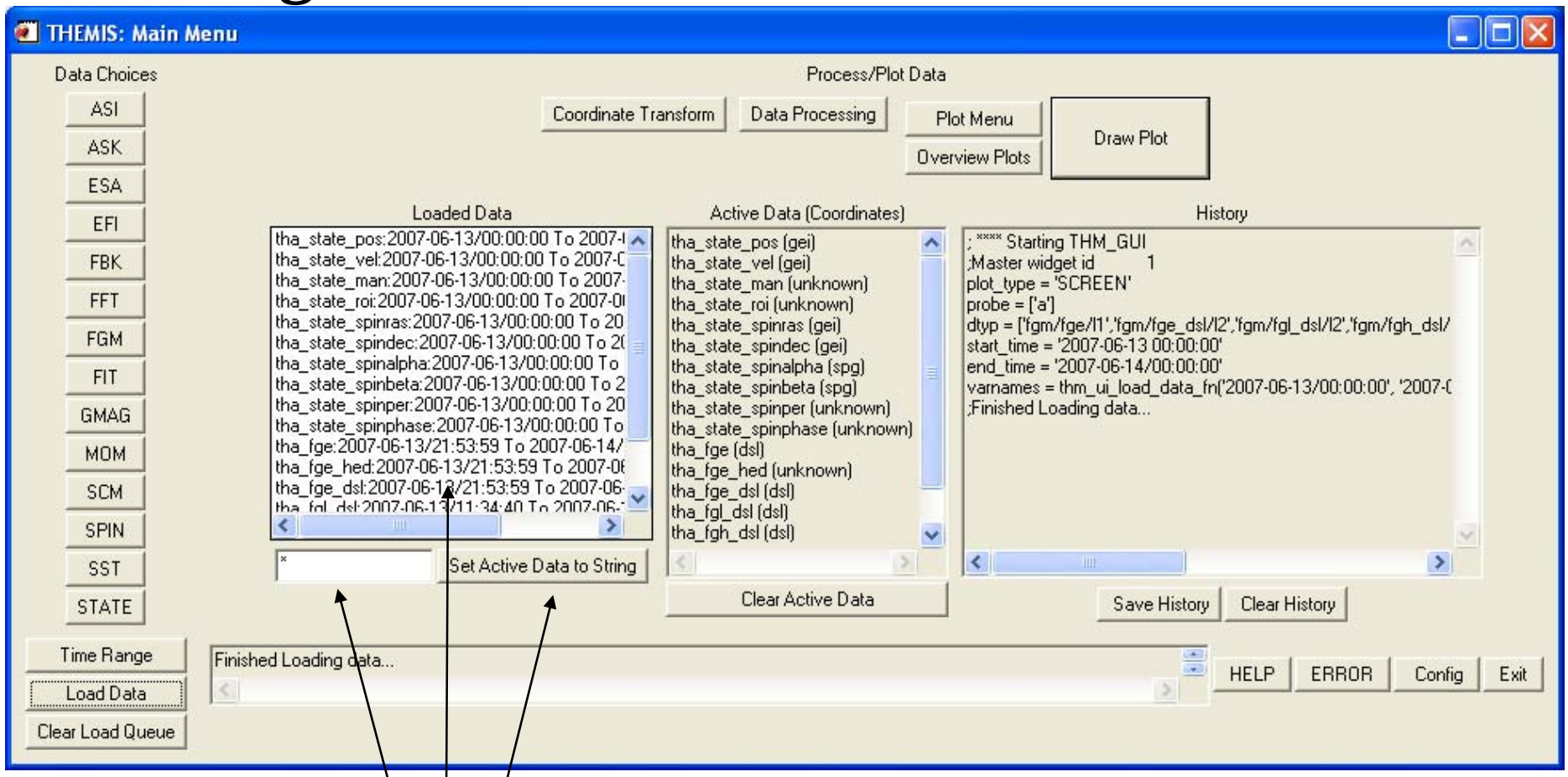
Now you can load data.

After loading, All data is “active”



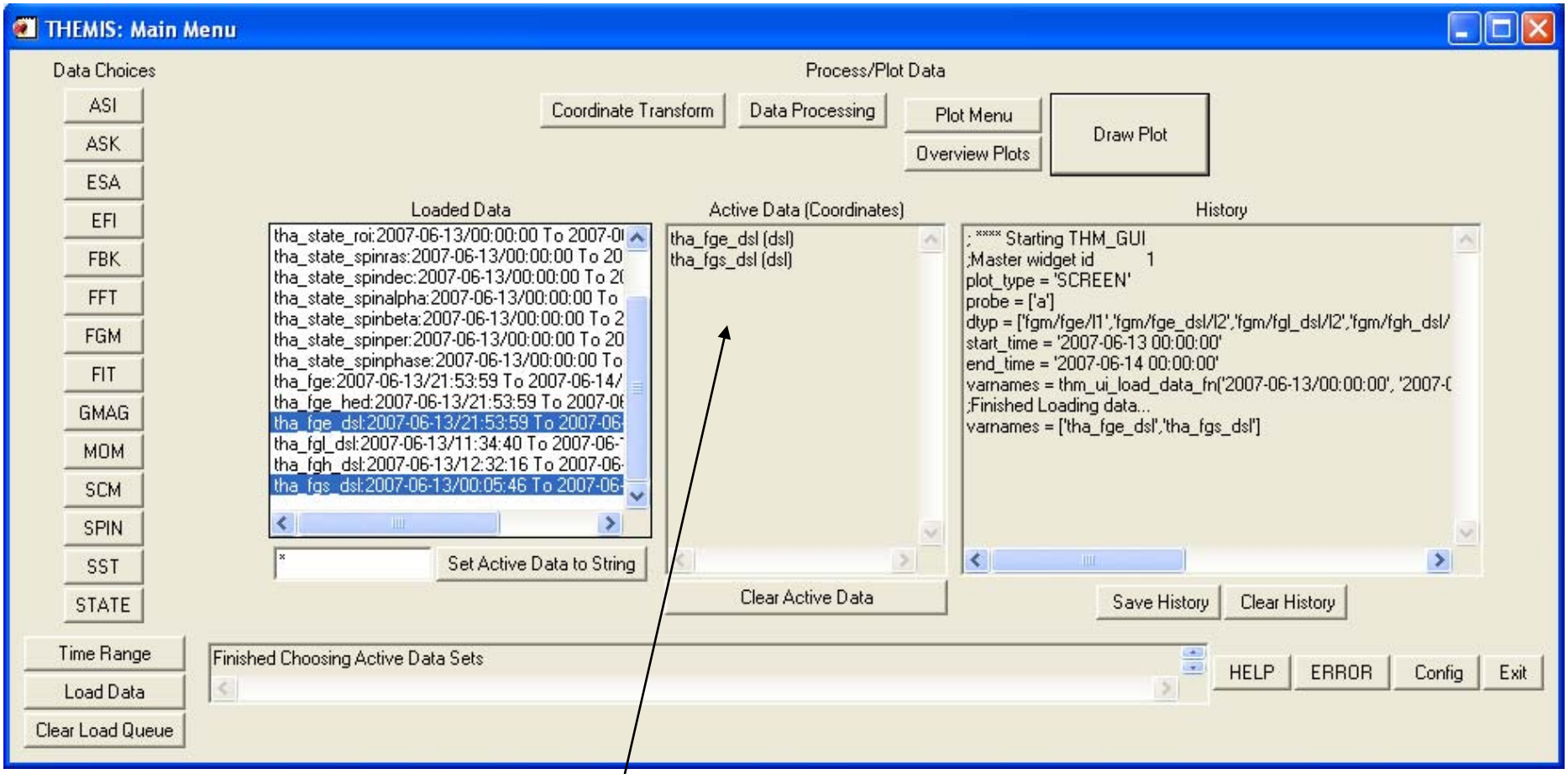
State data has been loaded automatically for FGM.

Setting Active Data:



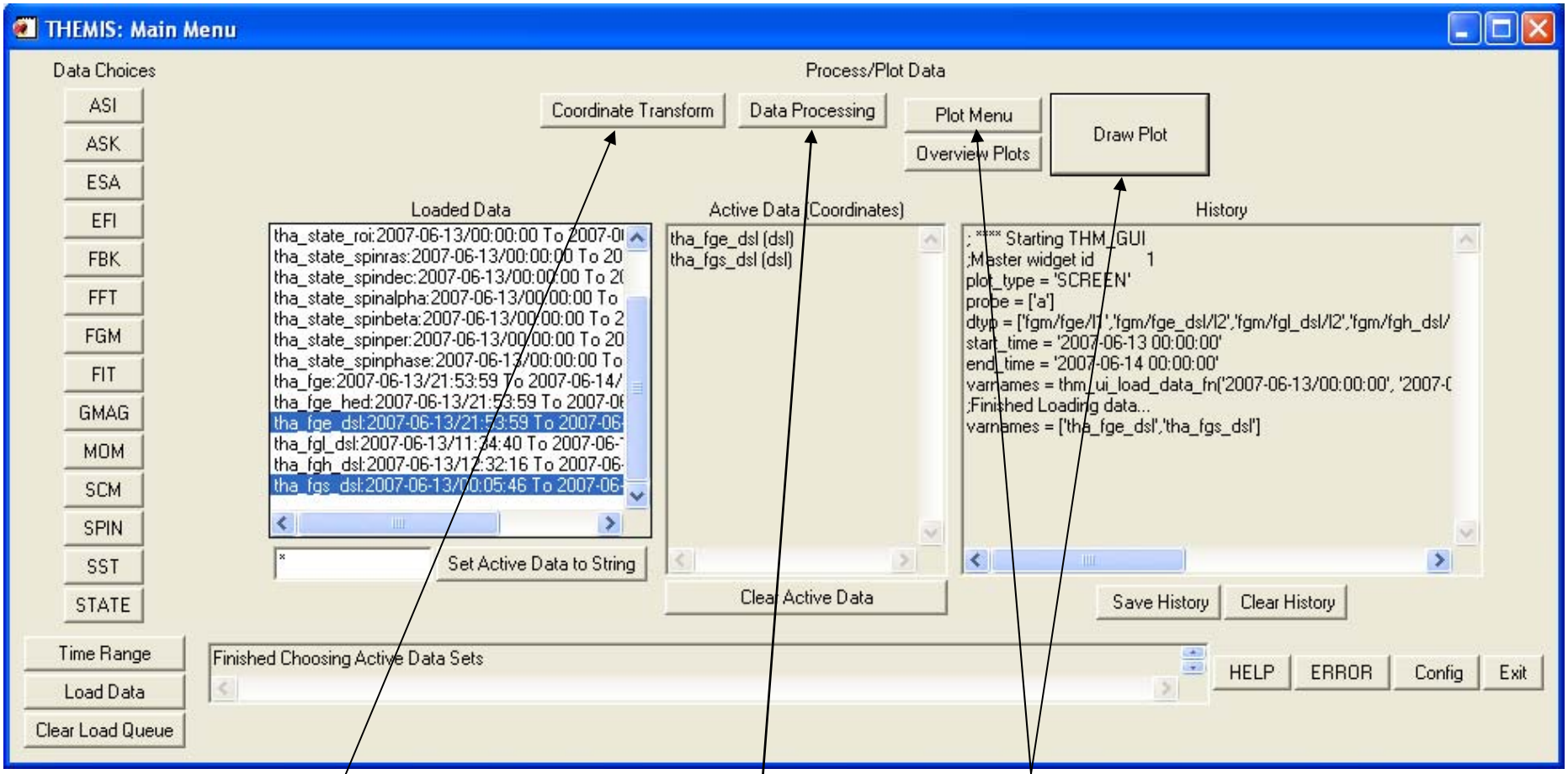
Type a string, or click to set data to “active”

Active Data Window:

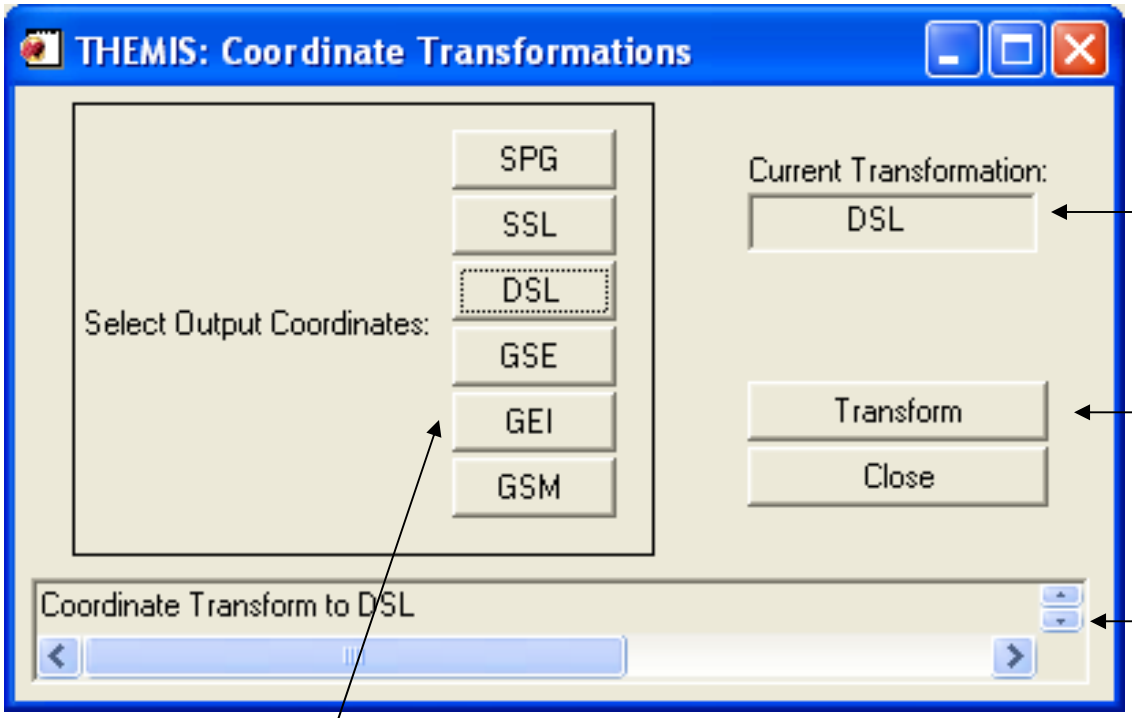


Selected data is now active

What next?


THEMIS: Main Menu
Data Choices
ASI
ASK
ESA
EFI
FBK
FFT
FGM
FIT
GMAG
MOM
SCM
SPIN
SST
STATE
Process/Plot Data
Coordinate Transform
Data Processing
Plot Menu
Overview Plots
Draw Plot
Loaded Data
tha_state_roi:2007-06-13/00:00:00 To 2007-0
tha_state_spinras:2007-06-13/00:00:00 To 20
tha_state_spindec:2007-06-13/00:00:00 To 2(
tha_state_spinalpha:2007-06-13/00:00:00 To
tha_state_spinbeta:2007-06-13/00:00:00 To 2
tha_state_spinper:2007-06-13/00:00:00 To 20
tha_state_spinphase:2007-06-13/00:00:00 To
tha_fge:2007-06-13/21:53:59 To 2007-06-14/
tha_fge_hed:2007-06-13/21:53:59 To 2007-0(
tha_fge_dsl:2007-06-13/21:53:59 To 2007-06
tha_fgl_dsl:2007-06-13/11:34:40 To 2007-06-
tha_fgh_dsl:2007-06-13/12:32:16 To 2007-06-
tha_fgs_dsl:2007-06-13/00:05:46 To 2007-06-
Active Data (Coordinates)
tha_fge_dsl (dsl)
tha_fgs_dsl (dsl)
History
; ***** Starting THM_GUI
;Master widget id 1
plot_type = 'SCREEN'
probe = ['a']
dtyp = ['fgm/fge/l1','fgm/fge_dsl/l2','fgm/fgl_dsl/l2','fgm/fgh_dsl/
start_time = '2007-06-13 00:00:00'
end_time = '2007-06-14 00:00:00'
varnames = thm_ui_load_data_fn('2007-06-13/00:00:00', '2007-(
;Finished Loading data...
varnames = ['tha_fge_dsl','tha_fgs_dsl']
*
Set Active Data to String
Clear Active Data
Save History
Clear History
Time Range
Load Data
Clear Load Queue
Finished Choosing Active Data Sets
HELP
ERROR
Config
Exit
Coordinate transform
Data Processing
Plotting

Coordinate Transform:



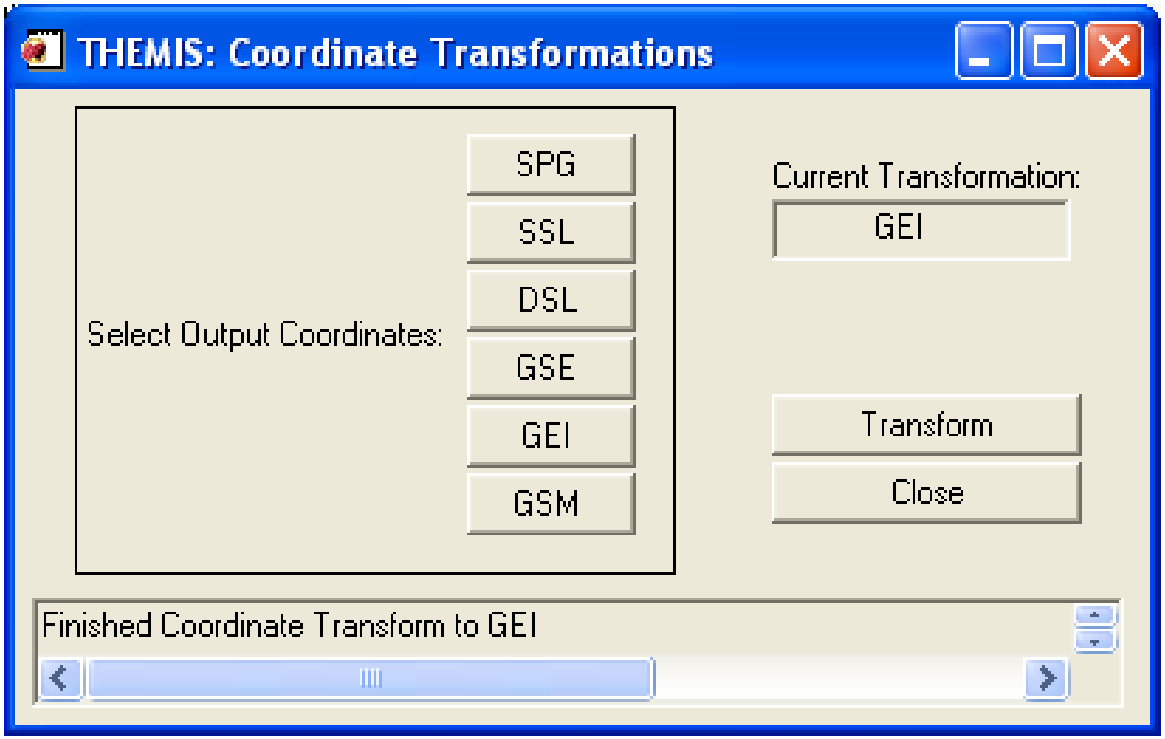
Shows current transform

Click here to perform the transformation

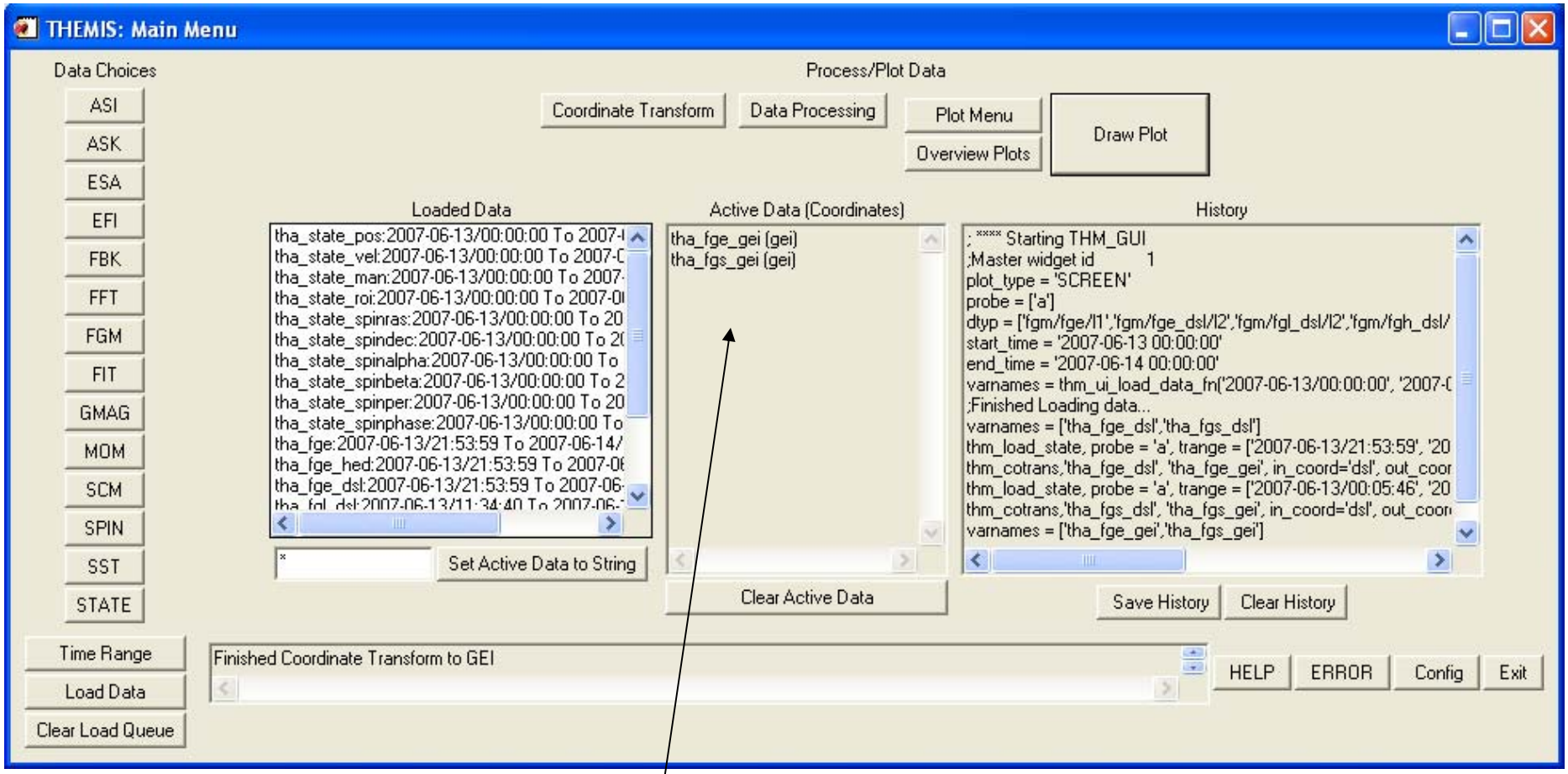
Message window will show warnings, errors, and progress

Click one of these to choose output coordinates

Clicked on GEI, and Transform Button:

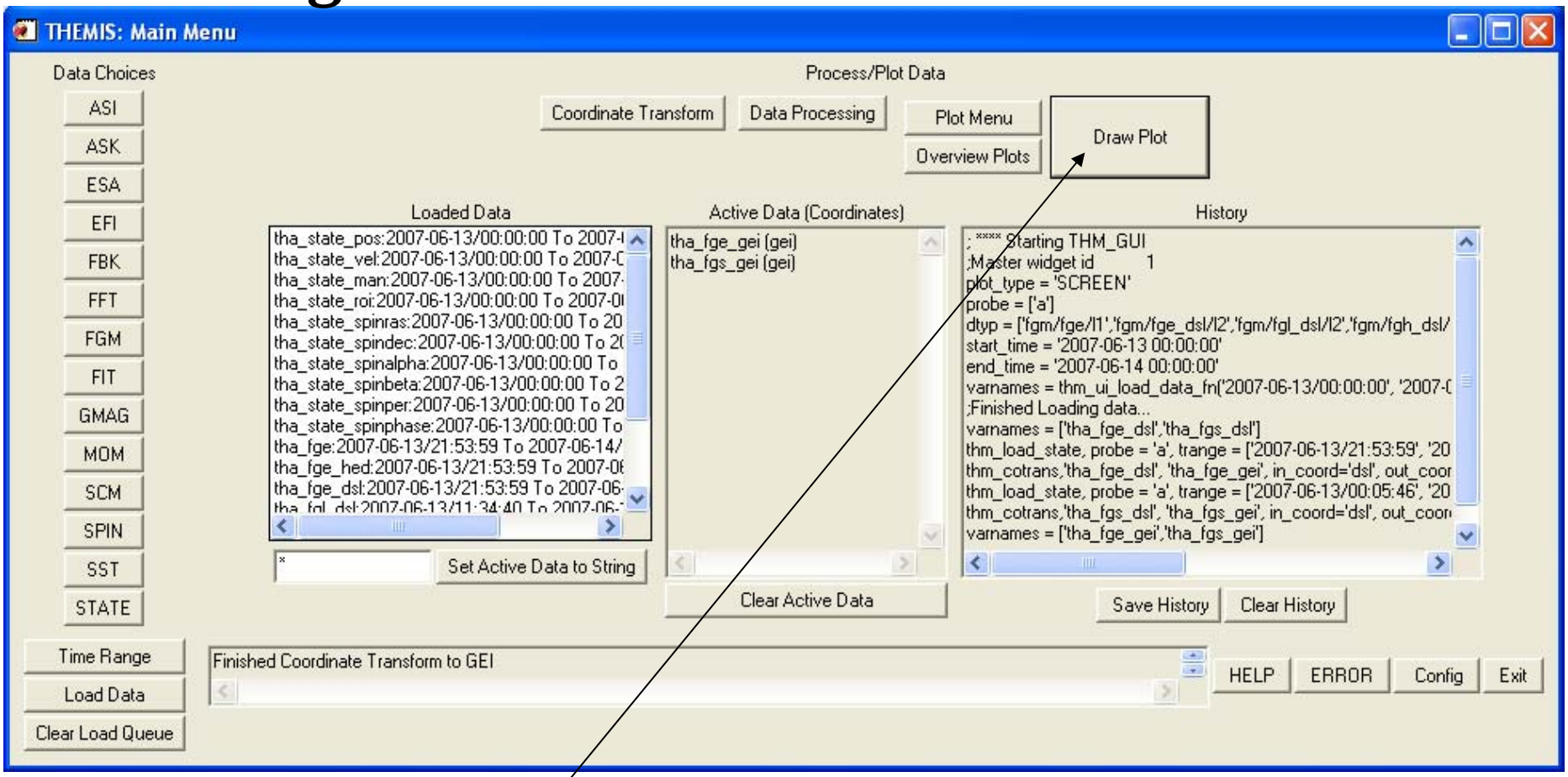


Back on the Main Menu:



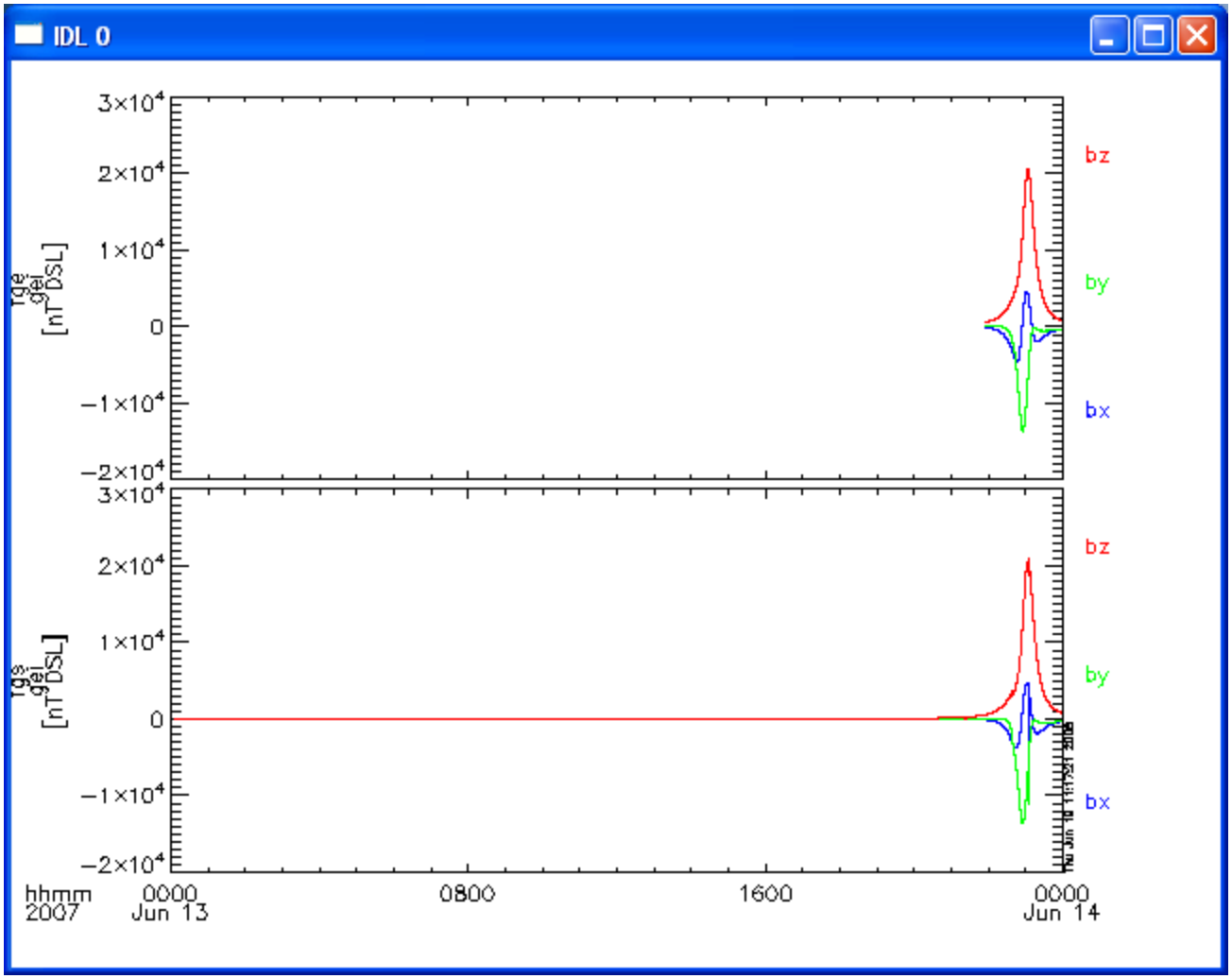
New “active” data. Remember – only active data is processed.

Plotting:

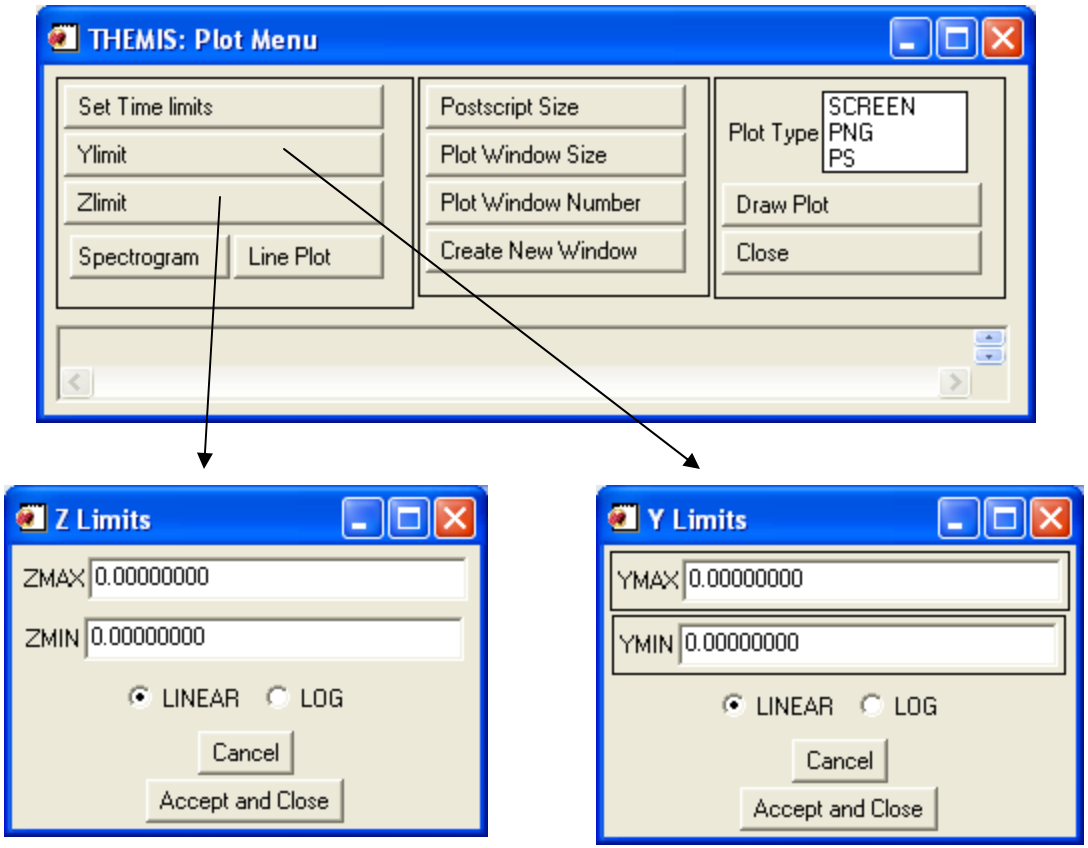


Click the “Draw Plot” button. Active data is plotted.

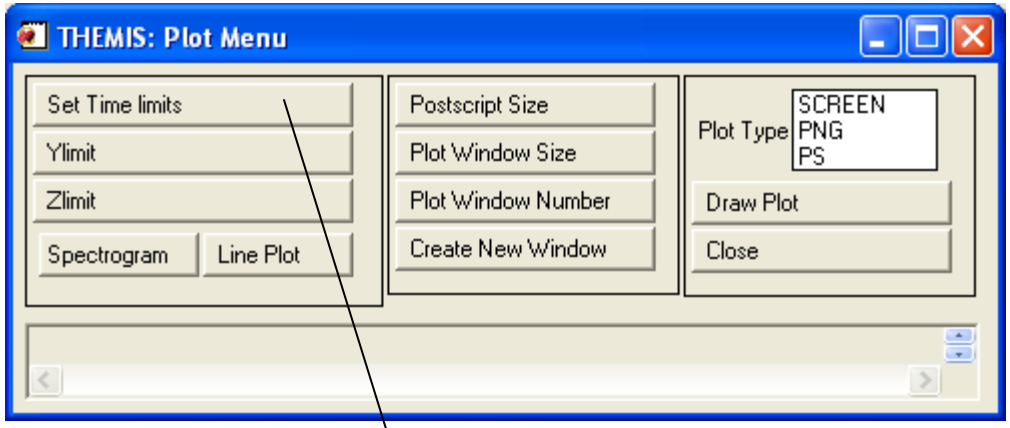
Plot:


IDL 0
3×10^4
2×10^4
1×10^4
0
−1×10^4
−2×10^4
bz
by
bx
hhmm
2007
0000
Jun 13
0800
1600
0000
Jun 14

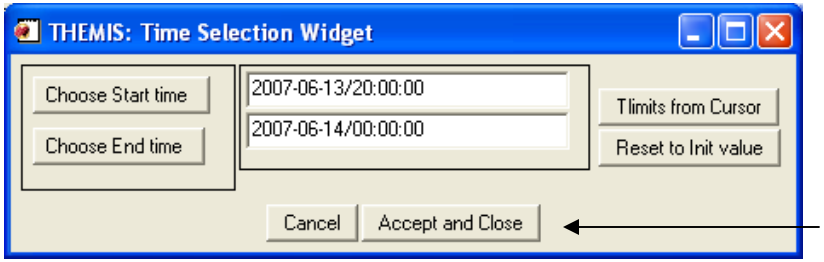
Plot Menu:


THEMIS: Plot Menu
Set Time limits
Ylimit
Zlimit
Spectrogram
Line Plot
Postscript Size
Plot Window Size
Plot Window Number
Create New Window
Plot Type
SCREEN
PNG
PS
Draw Plot
Close
Z Limits
ZMAX 0.00000000
ZMIN 0.00000000
LINEAR
LOG
Cancel
Accept and Close
Y Limits
YMAX 0.00000000
YMIN 0.00000000
LINEAR
LOG
Cancel
Accept and Close

Plot Menu: Rescale Active Data

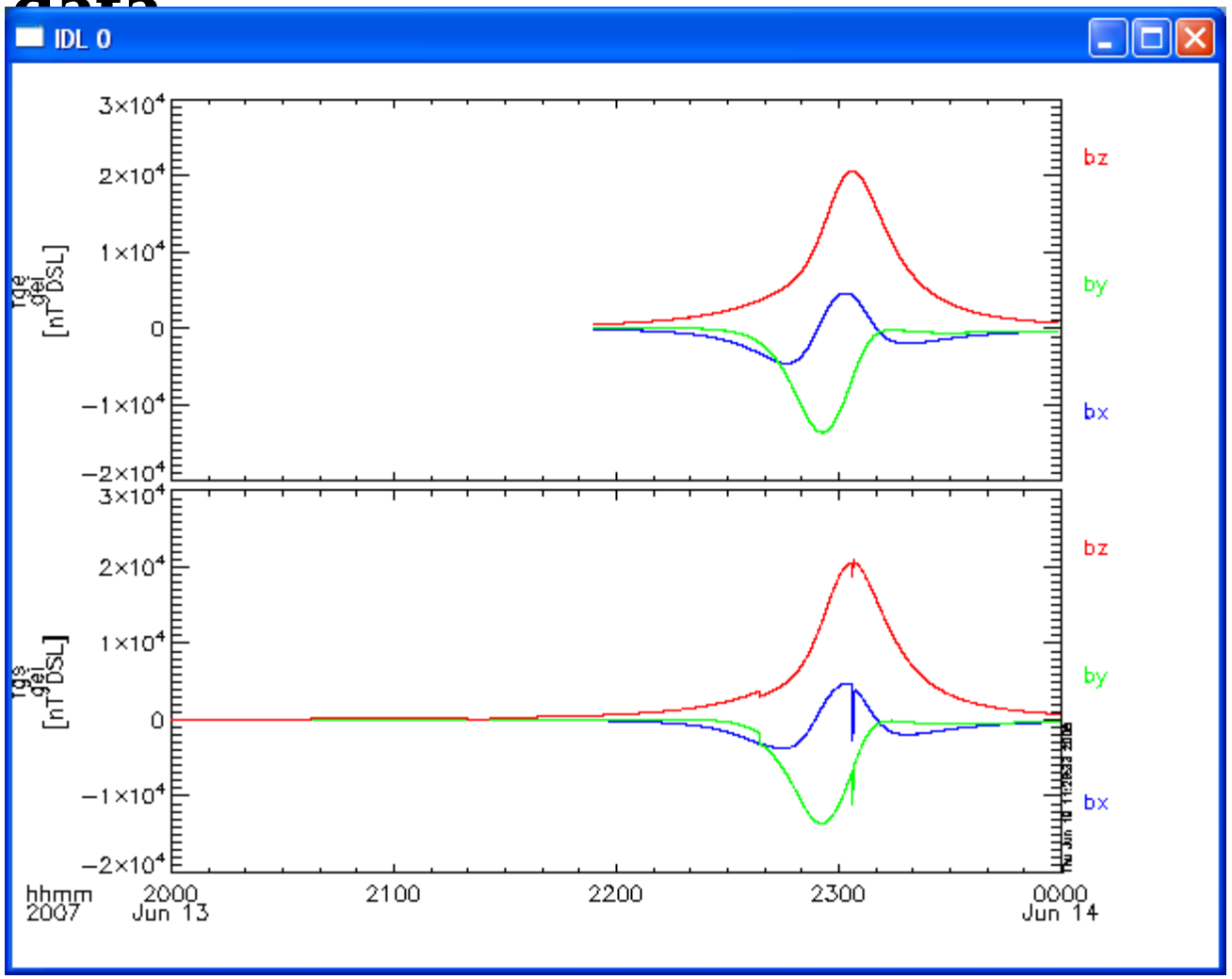


Enter new start time

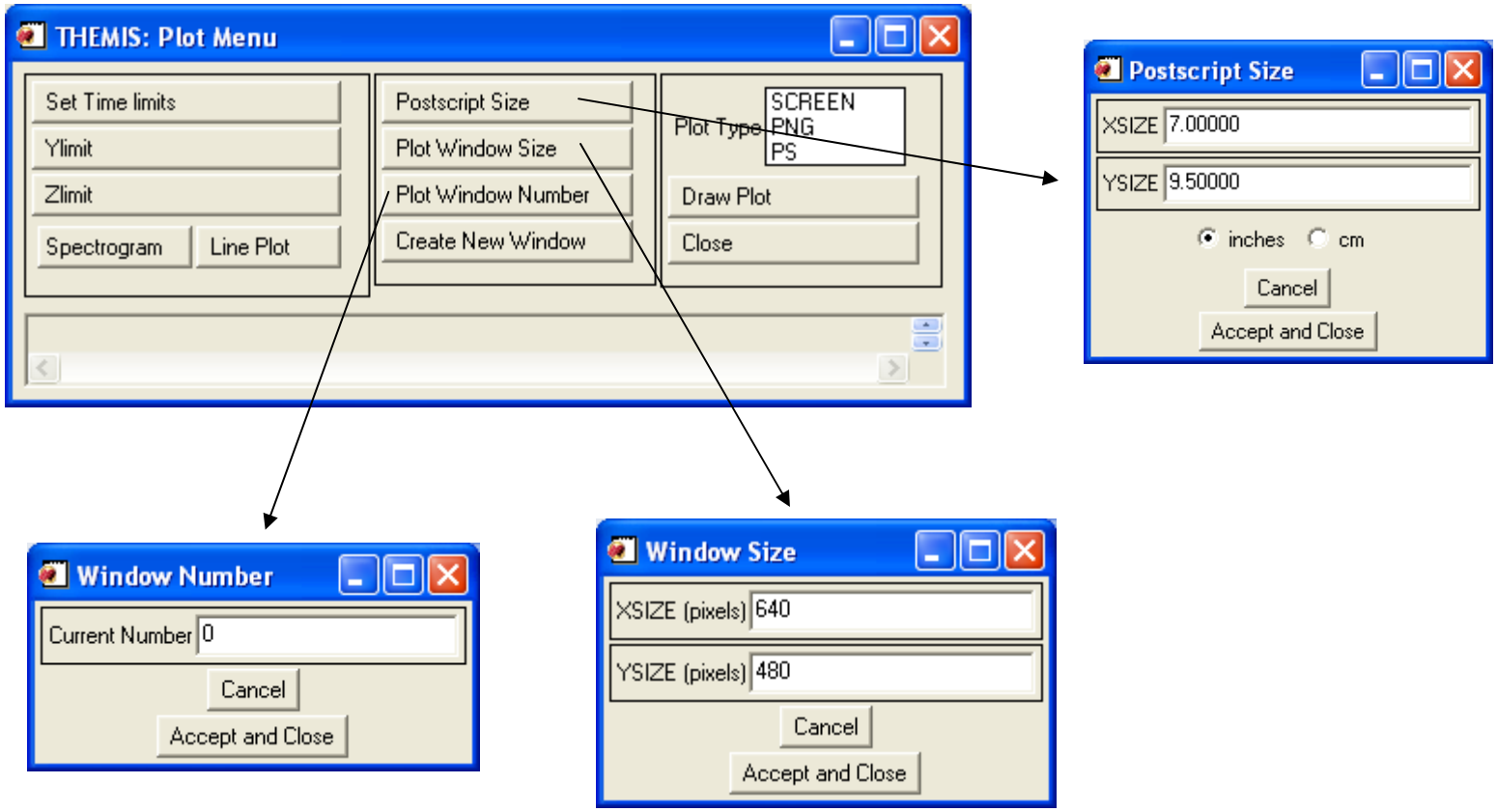


You must click here, in order to accept the new start time.

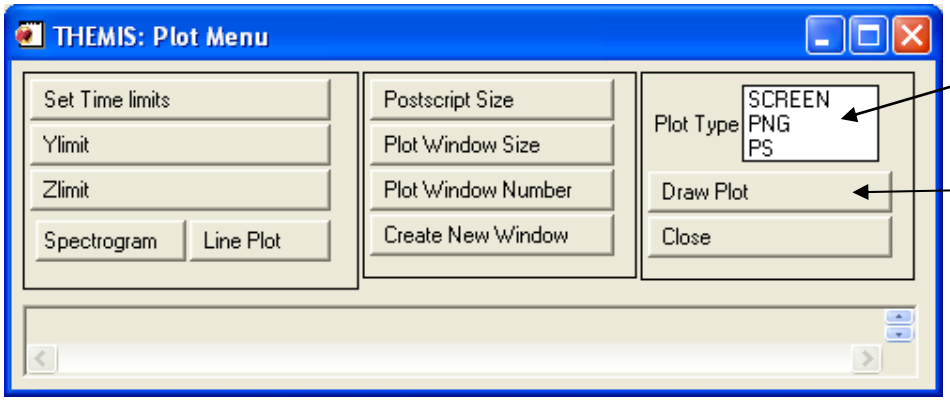
Plot Menu: New time limits automatically plots new data



Plot Menu: Setting Size and Window options.



Plot Menu: Setting “PNG” or “PS”



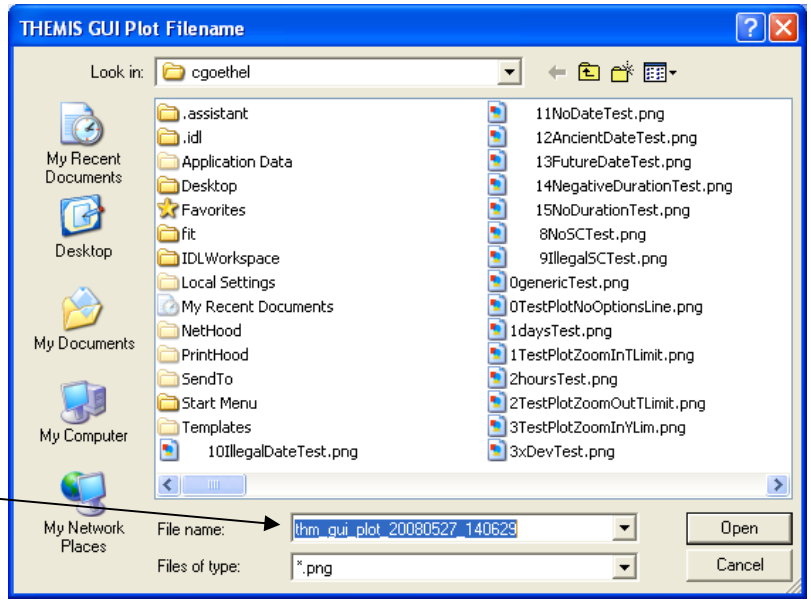
Click here to select output mode

Plots will not be made until you click here.

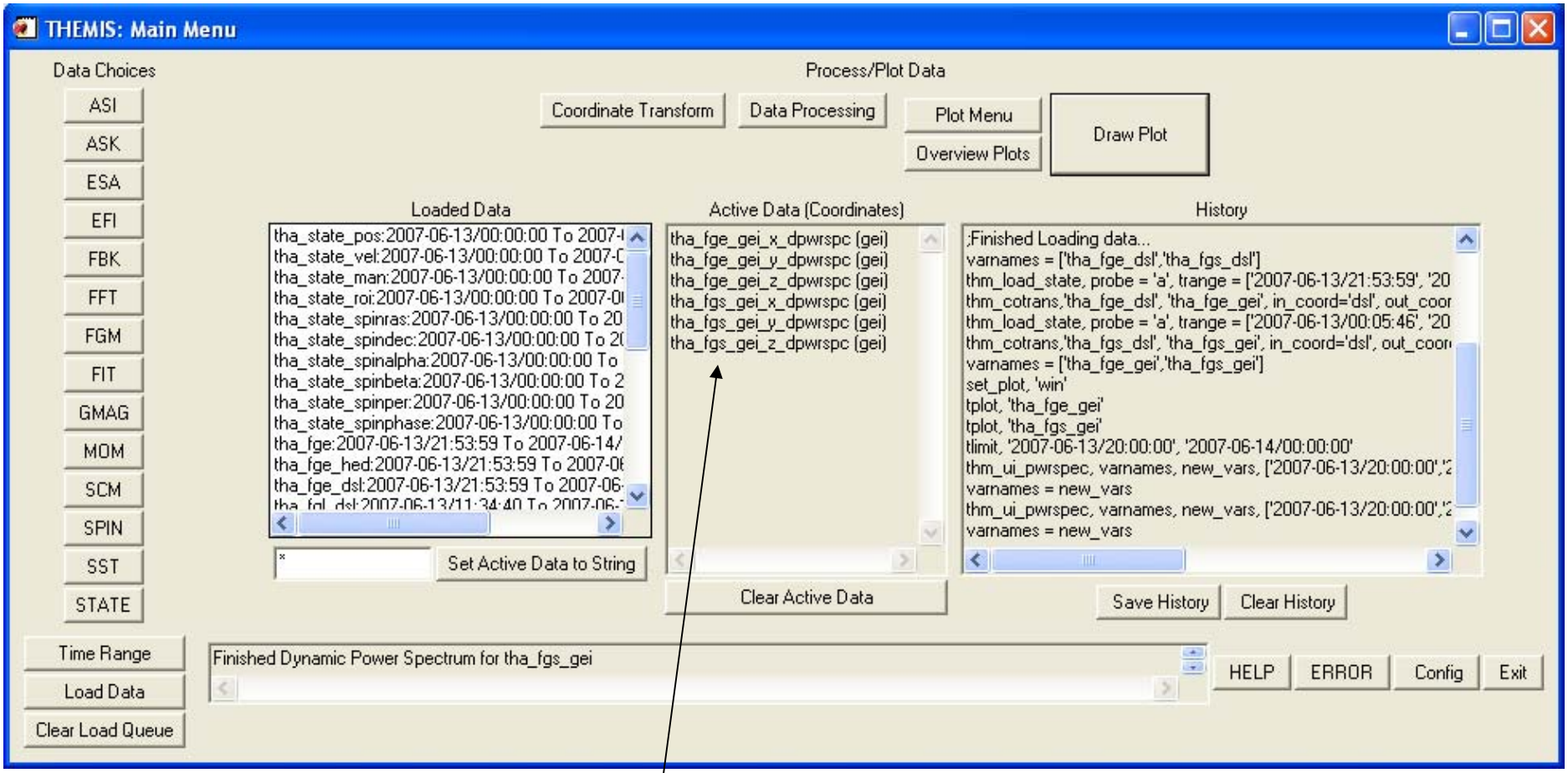
If a PNG or PS plot type was selected, a file selection window is displayed.

* Remember to click the Screen option to return to screen plots.

Click here to enter a file name

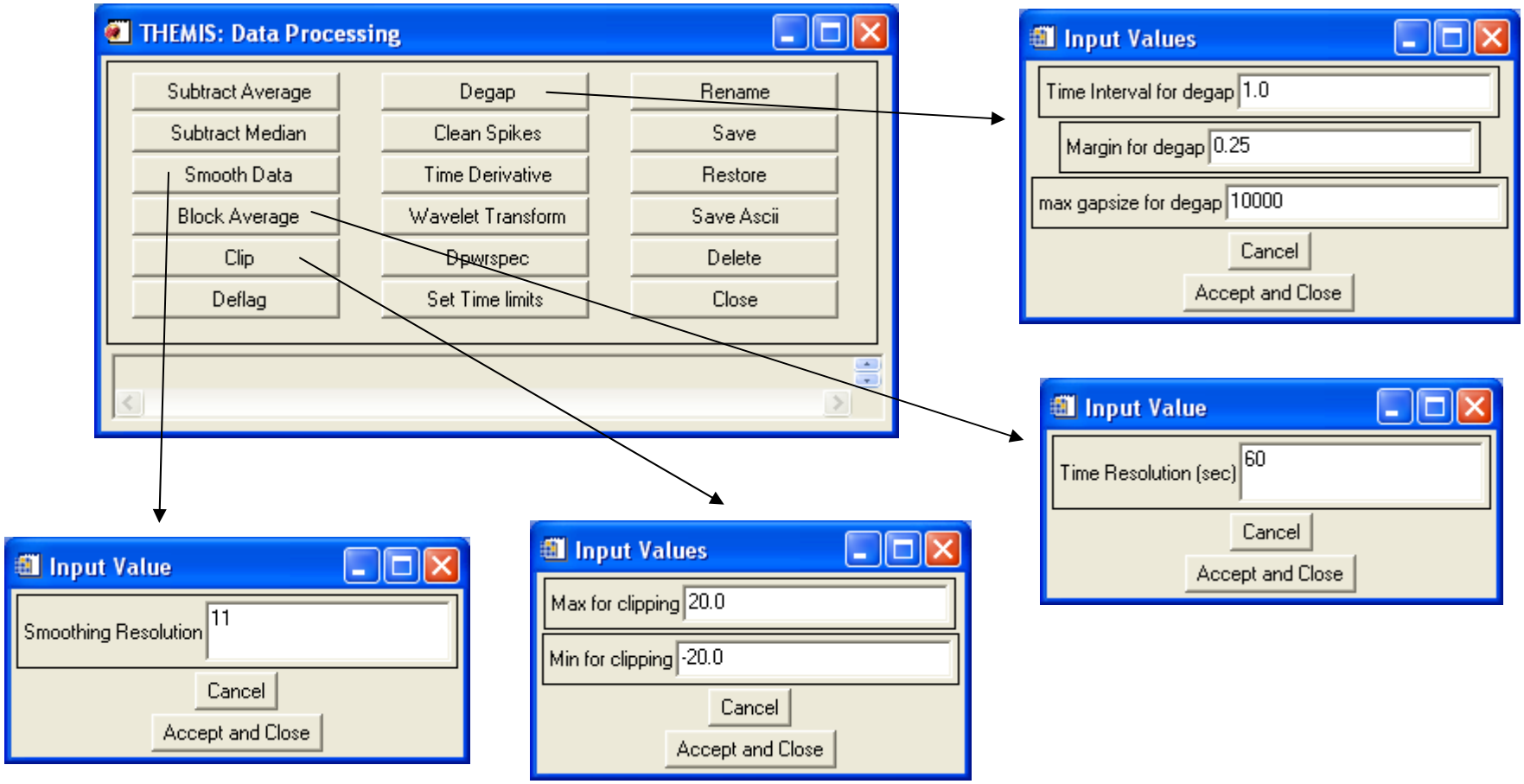


Data Processing Resets Active Data:

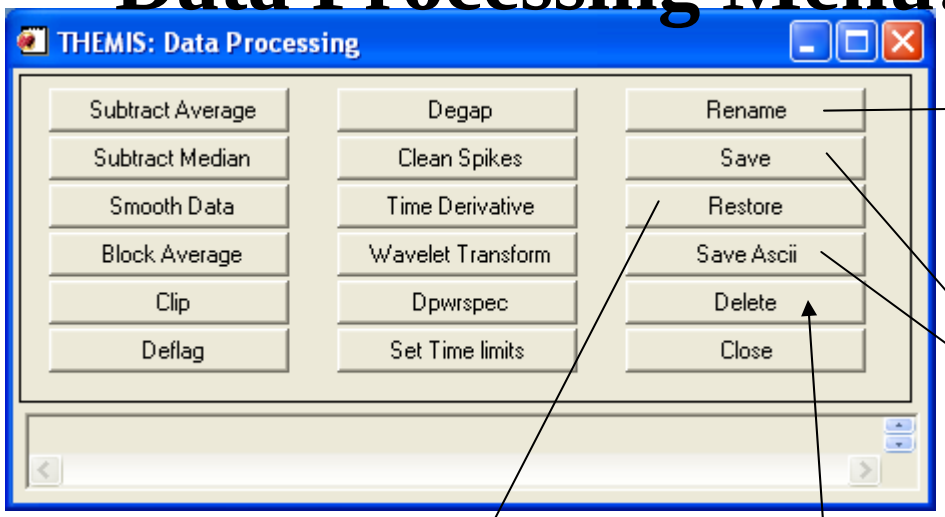


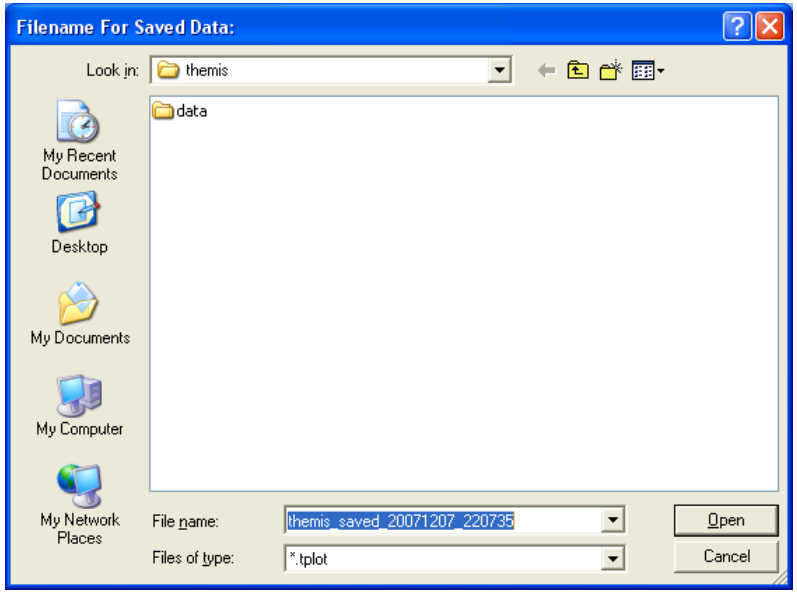
These processes reset the “active” data.

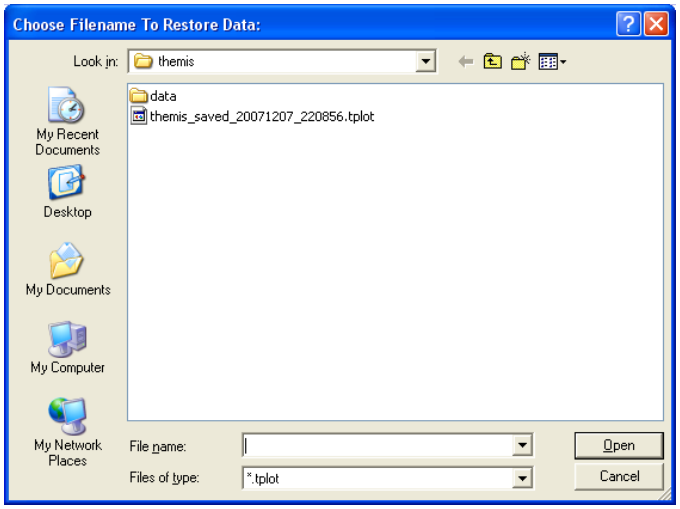
Data Processing Menu:



Data Processing Menu:

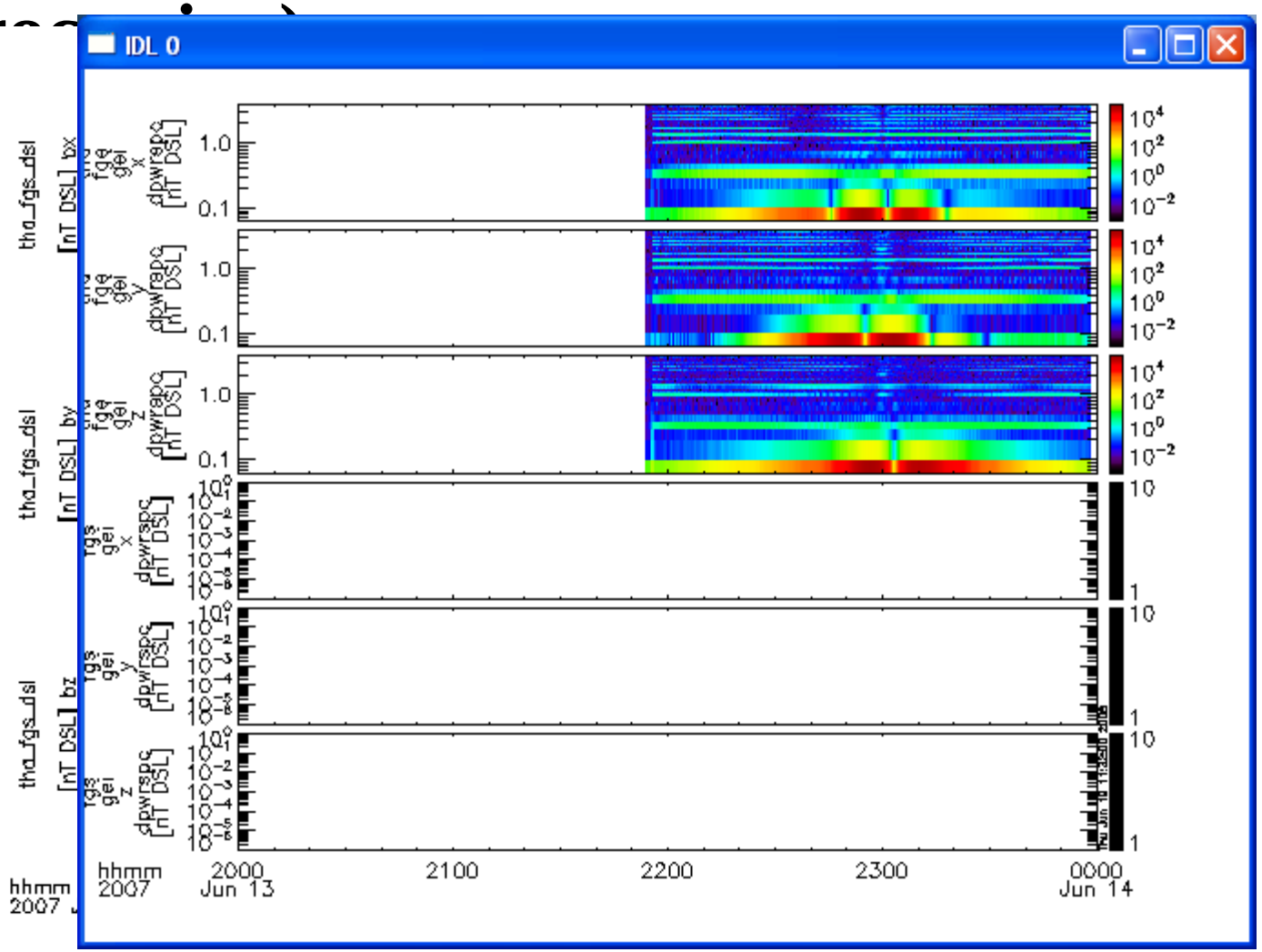




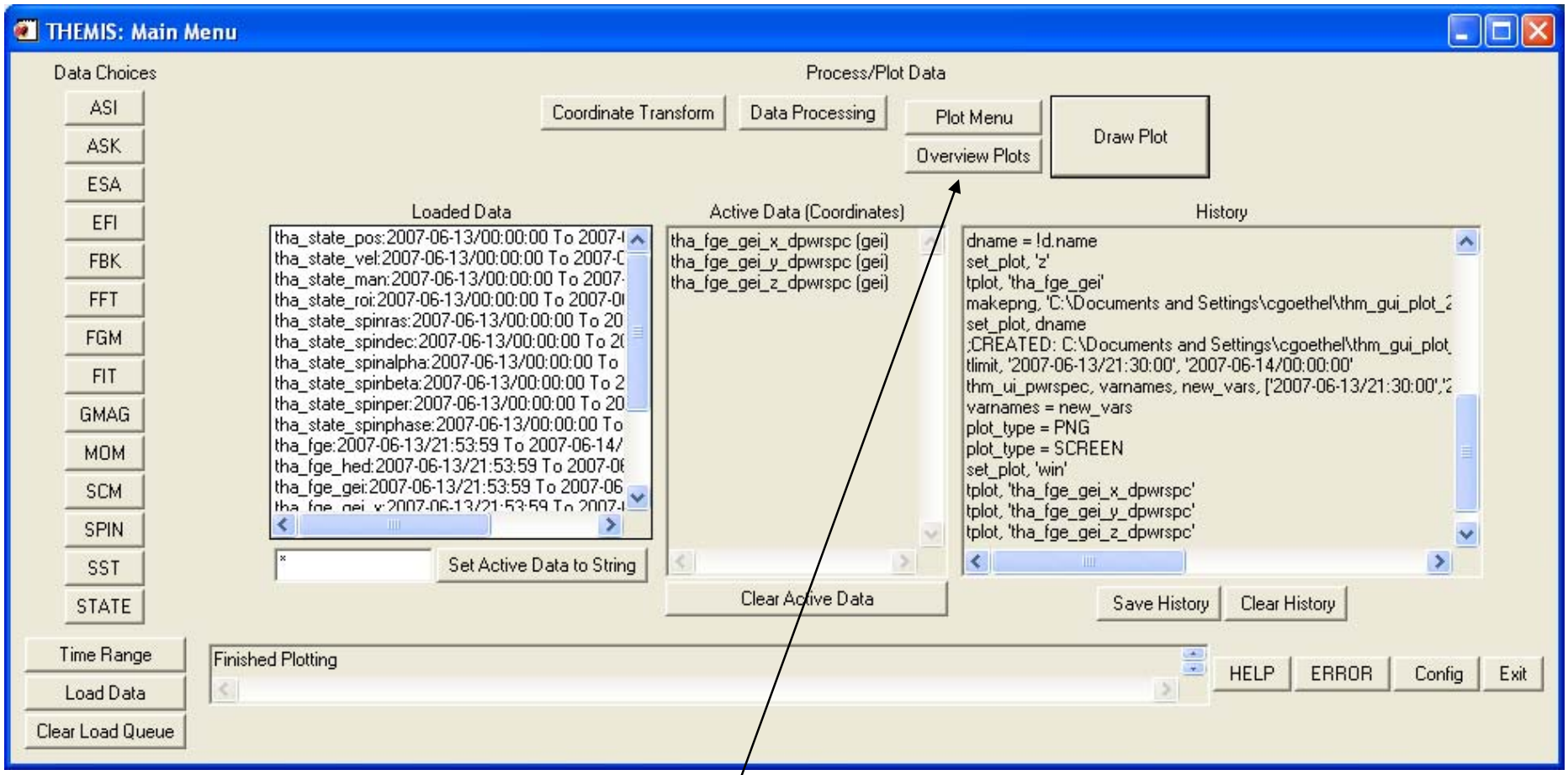


Deletes Active Data.

Plot of New Processed Data: (after dpwrspec pro



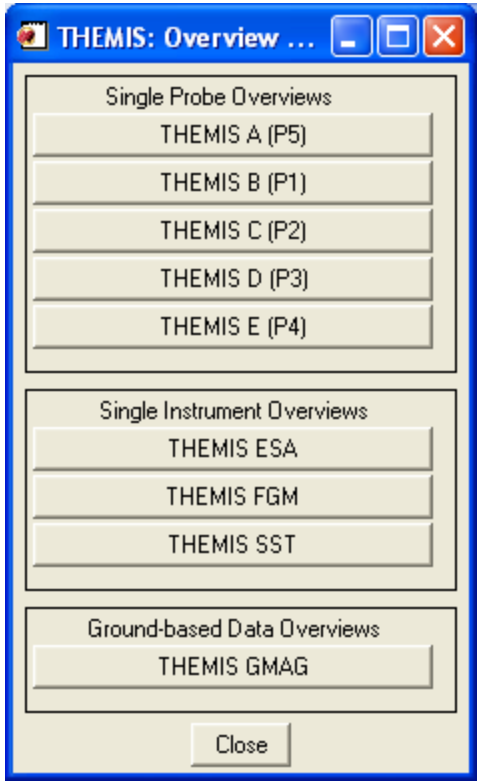
Overview Plots:



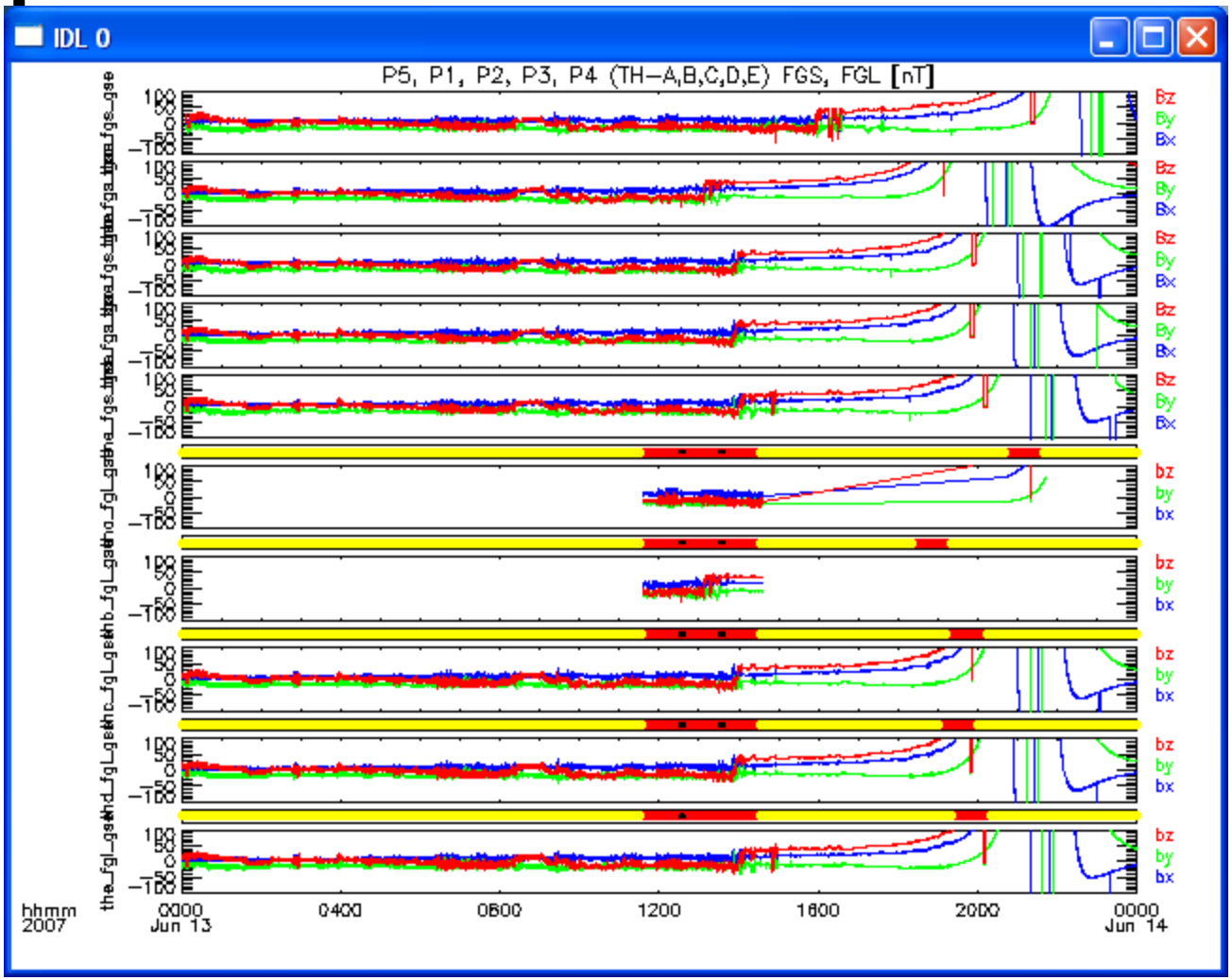
Click here for an overview plot:

Overview Plot Menu:

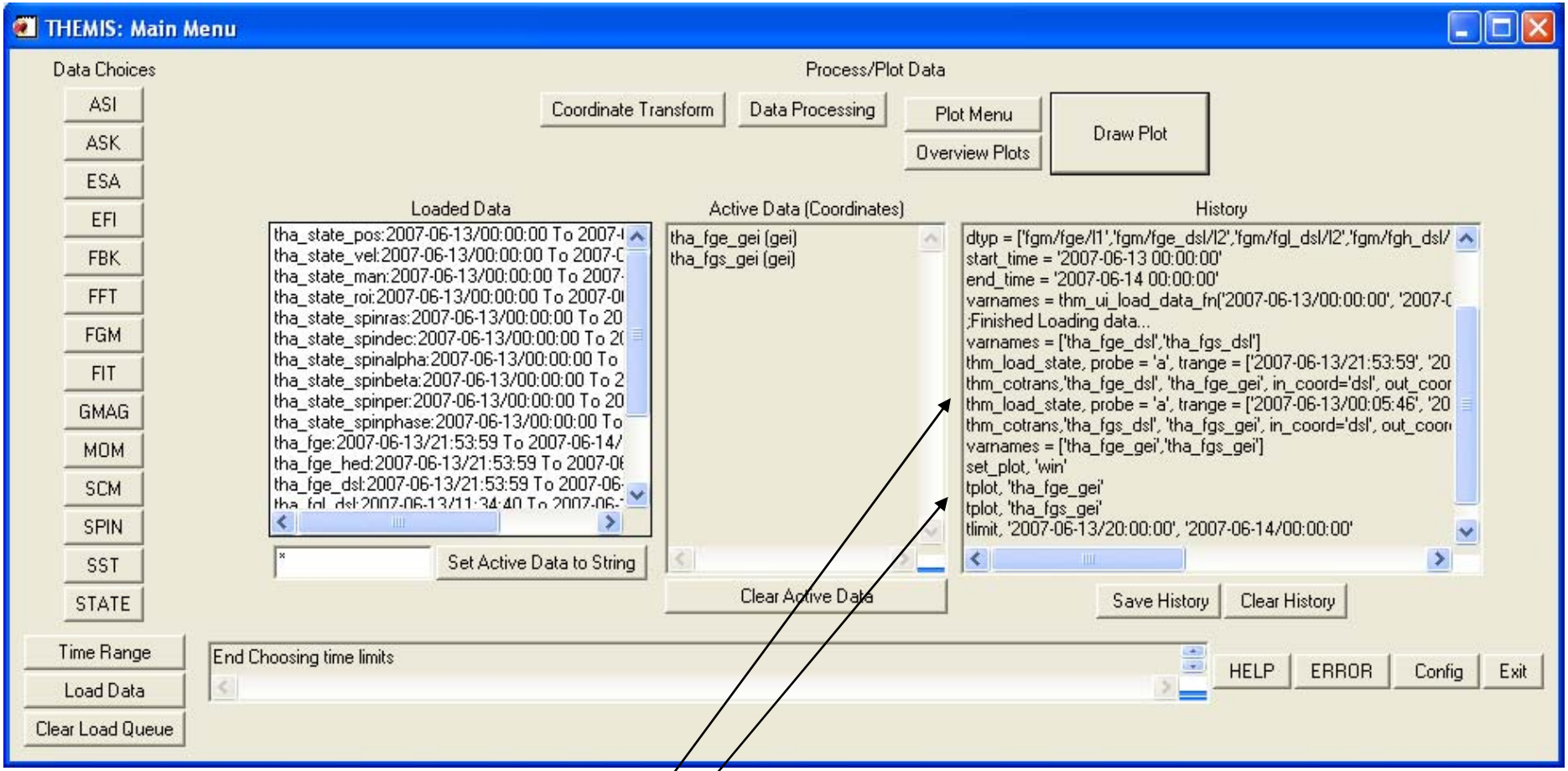
* Warning - this process might take awhile



Sample Overview Plot:

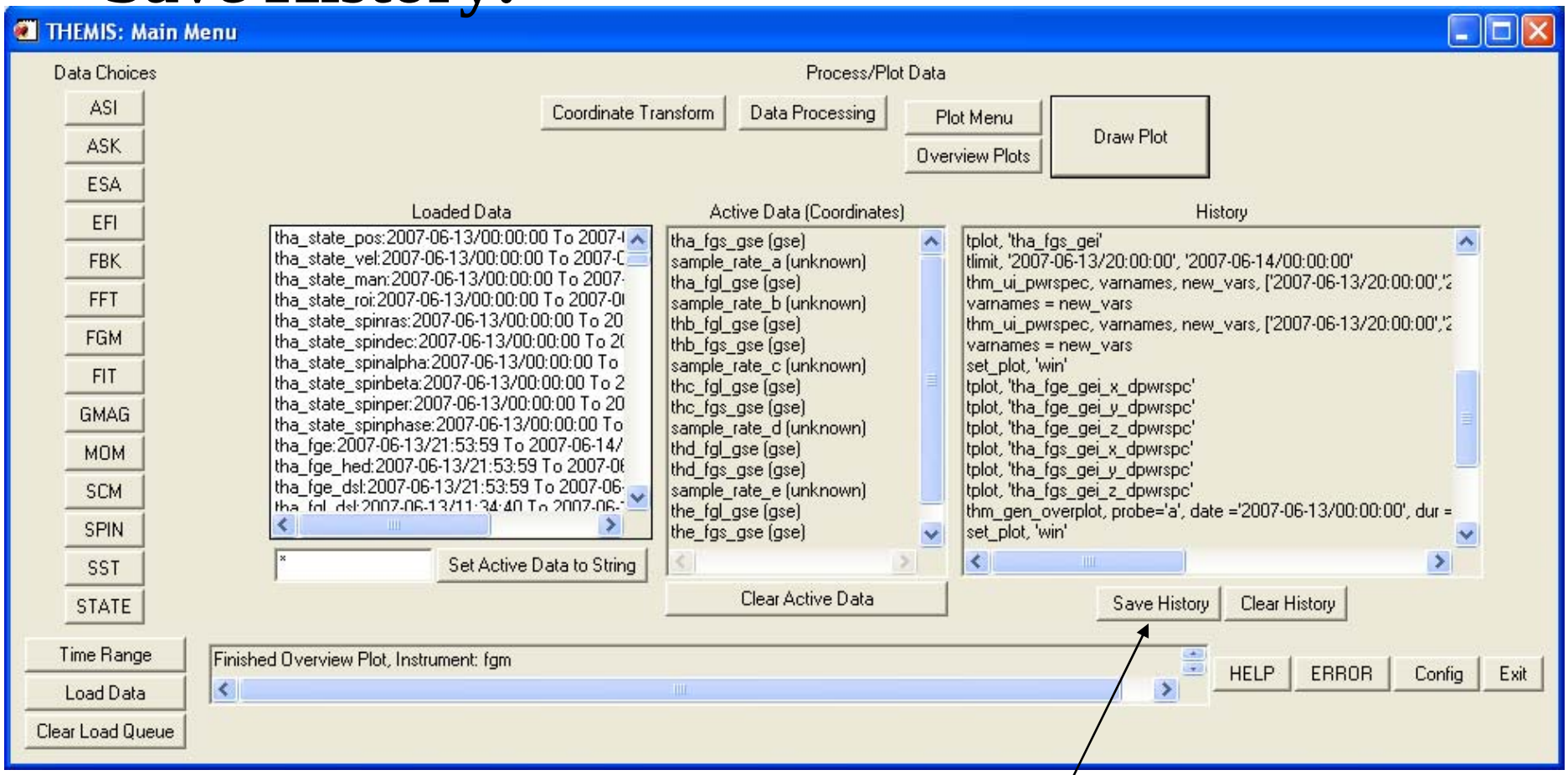


History Window:



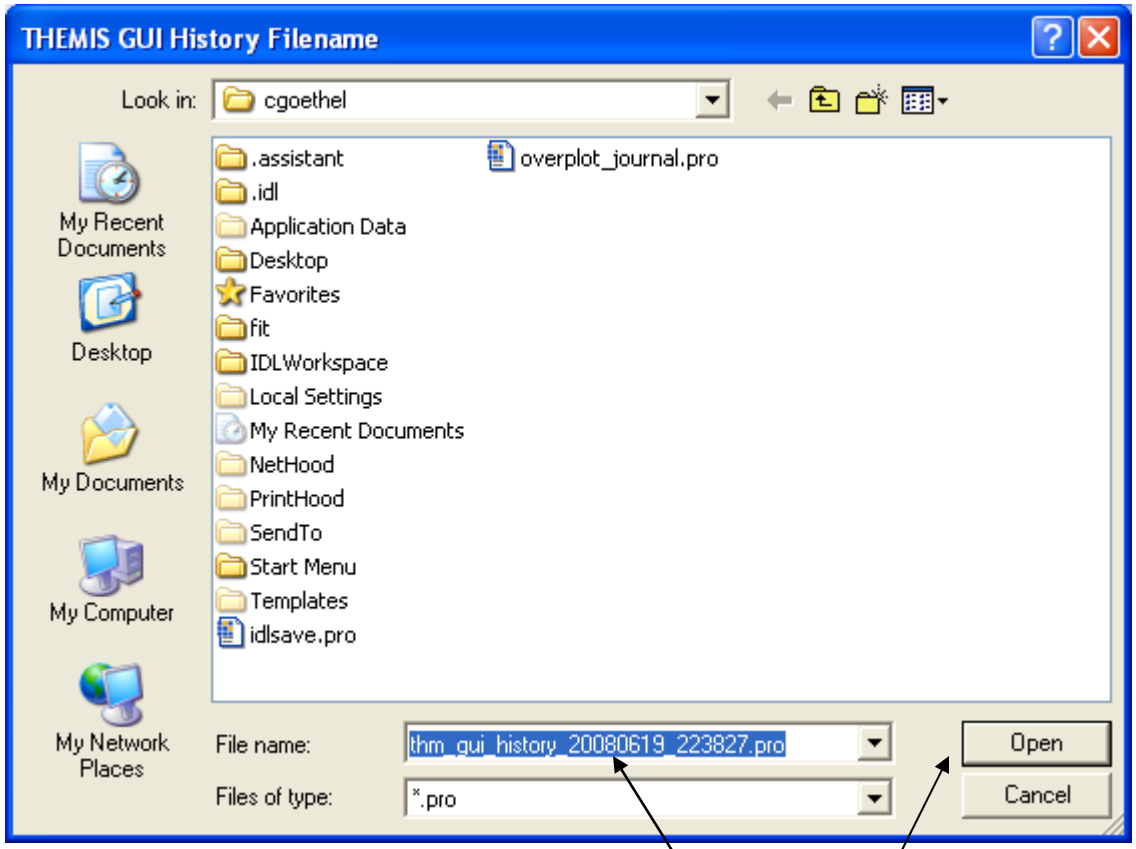
These are the IDL commands used.

Save History:



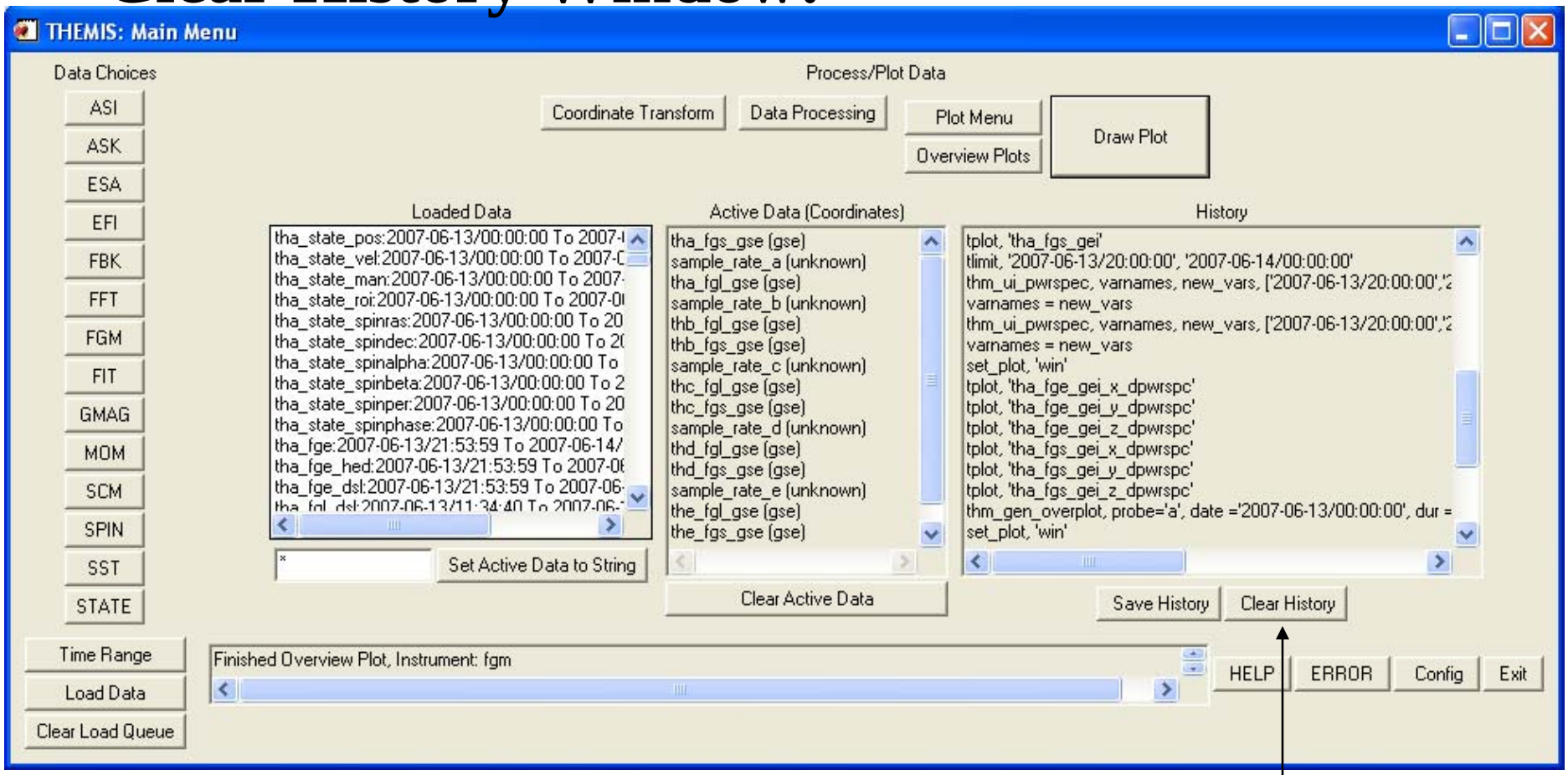
Click here to save history. Use when sending help request.

History File Selection Window:



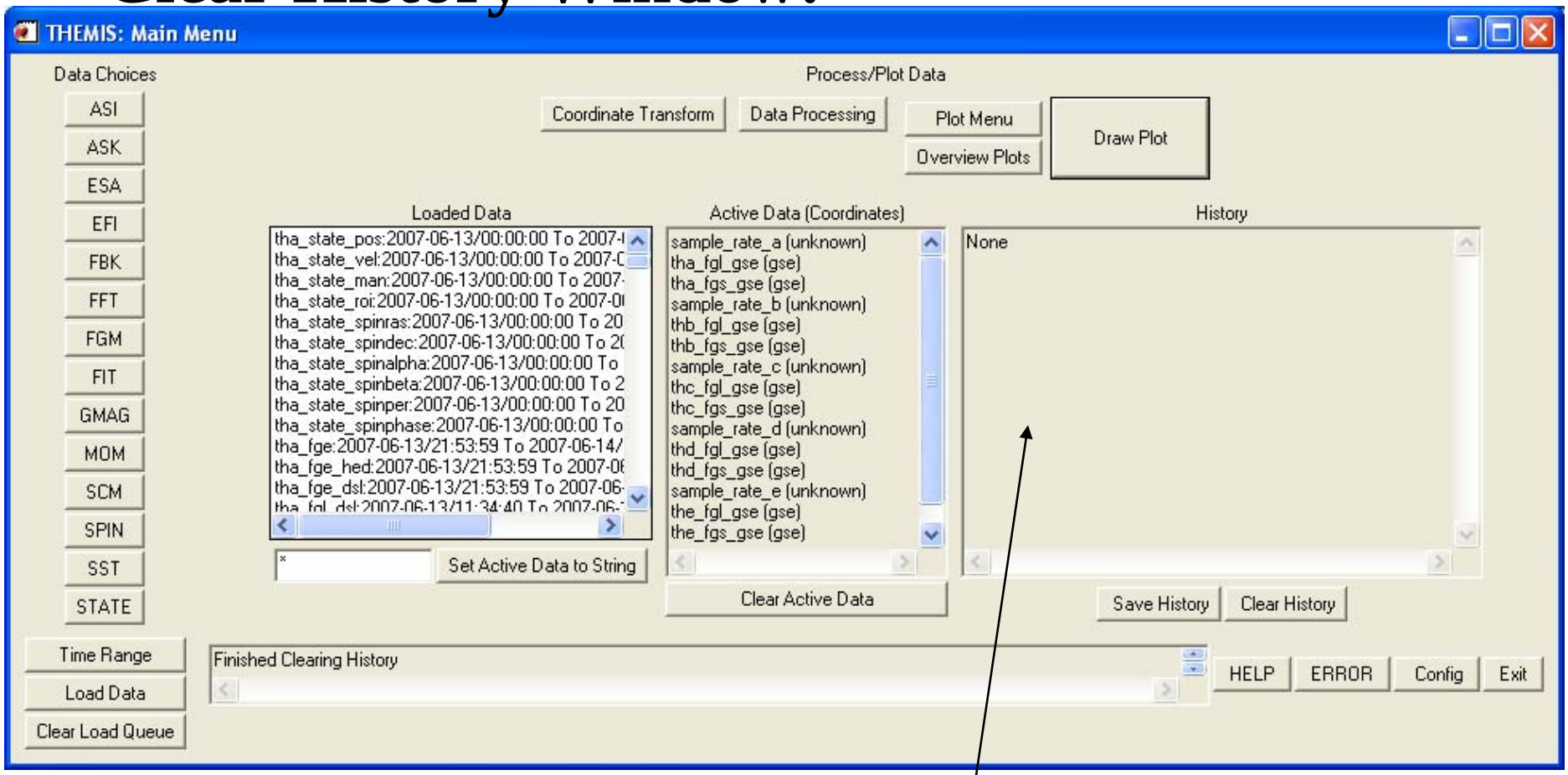
Select file name and save.

Clear History Window:



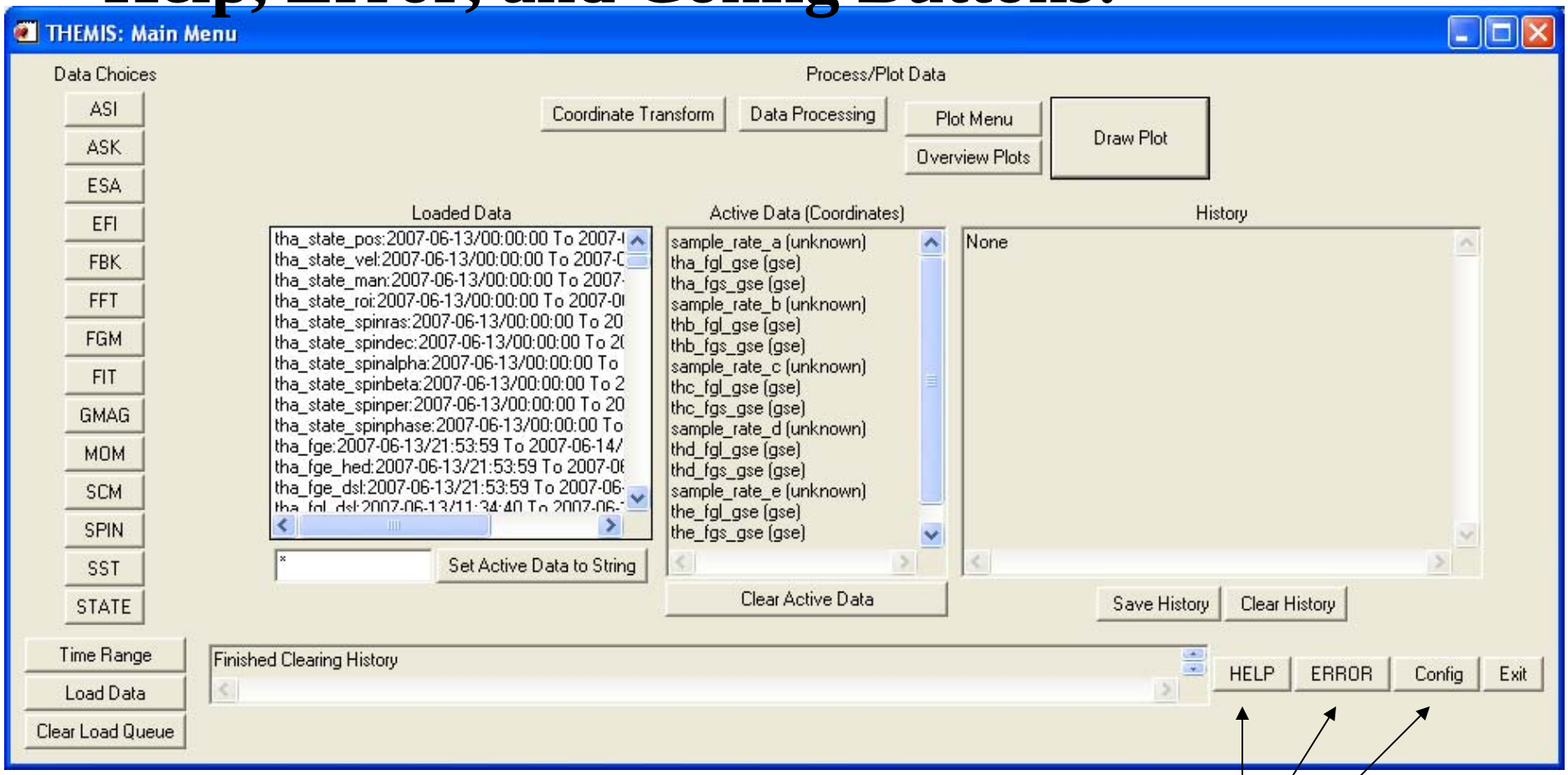
Click here to clear the window.

Clear History Window:



History has been cleared

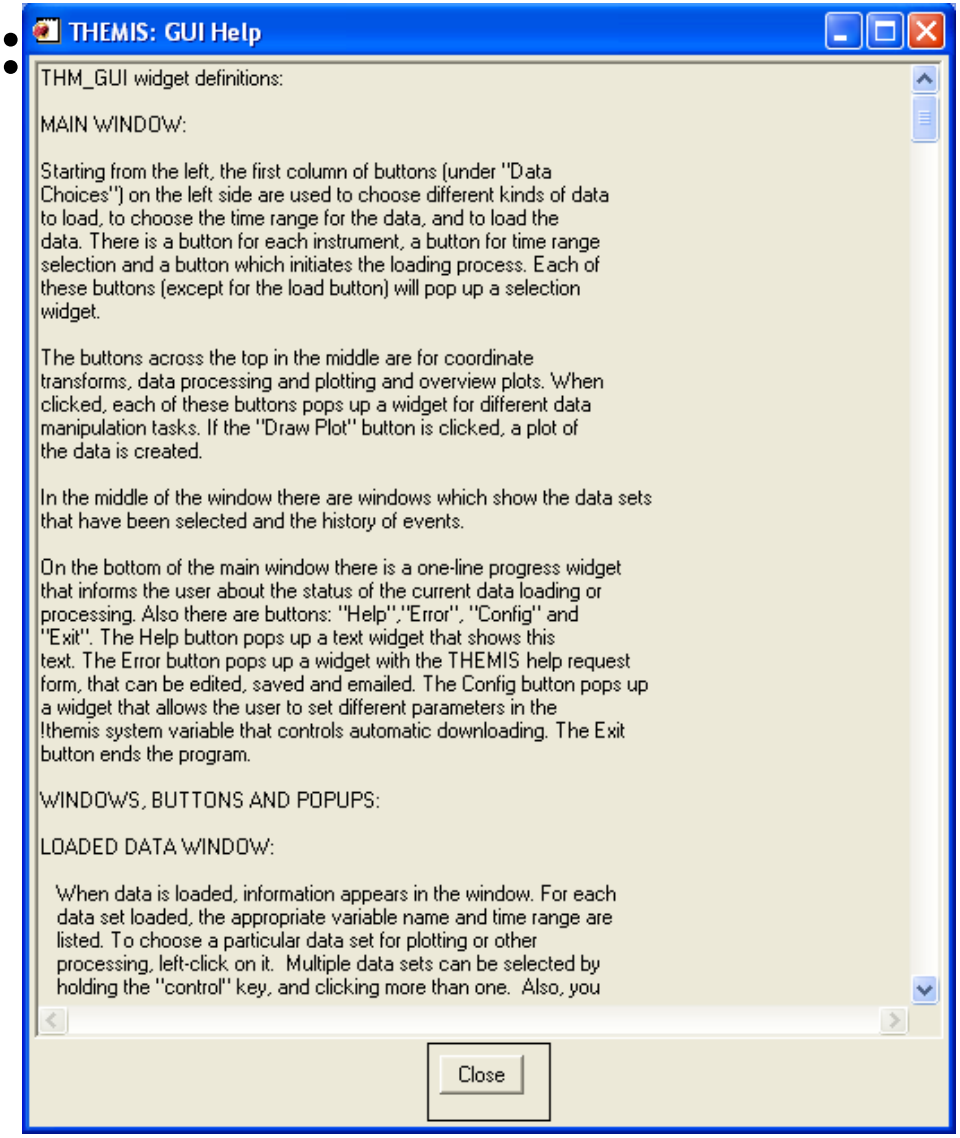
Help, Error, and Config Buttons:



Help, Error, and Config buttons

Help Window:

This has descriptions of all of the buttons and windows in the GUI.



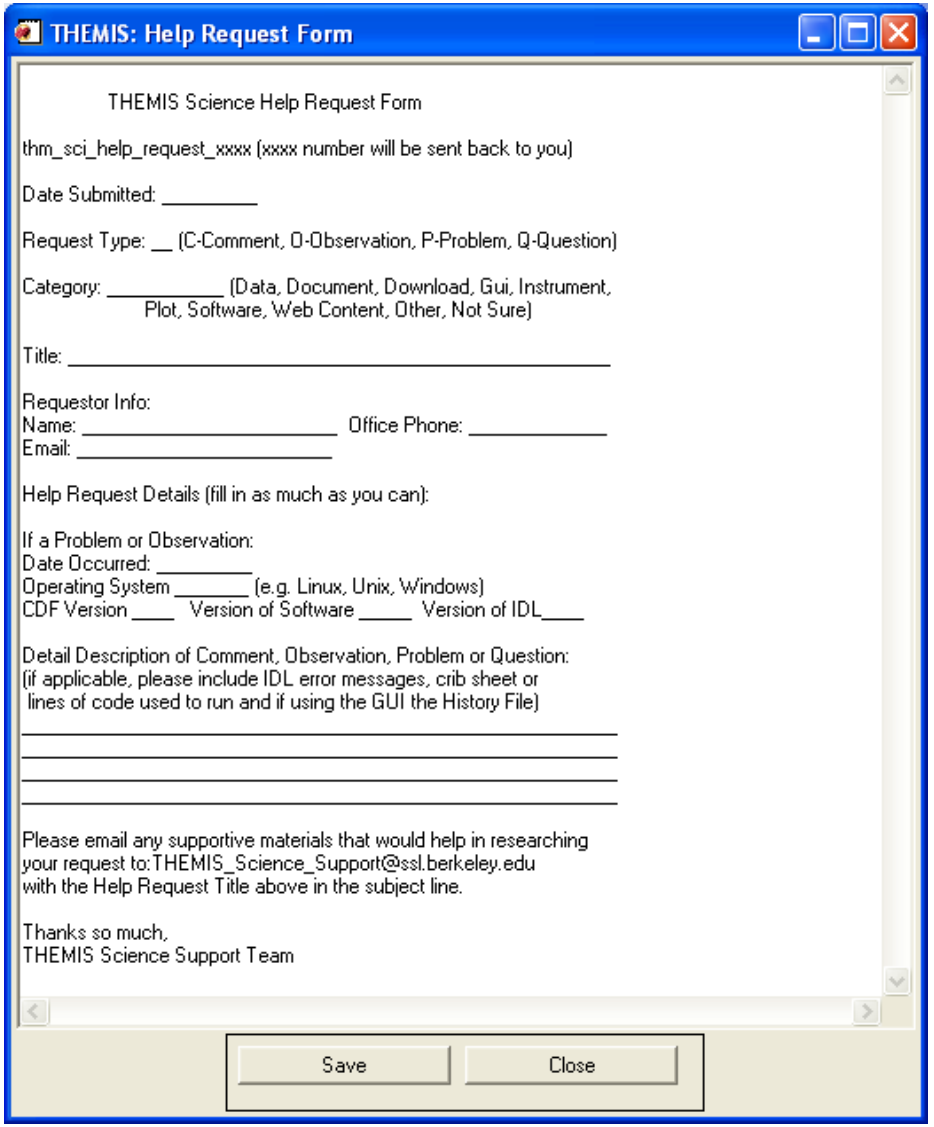
Error Window:

This should pop up automatically if there is a crash. Also you can get this by clicking the ERROR button on the main window.

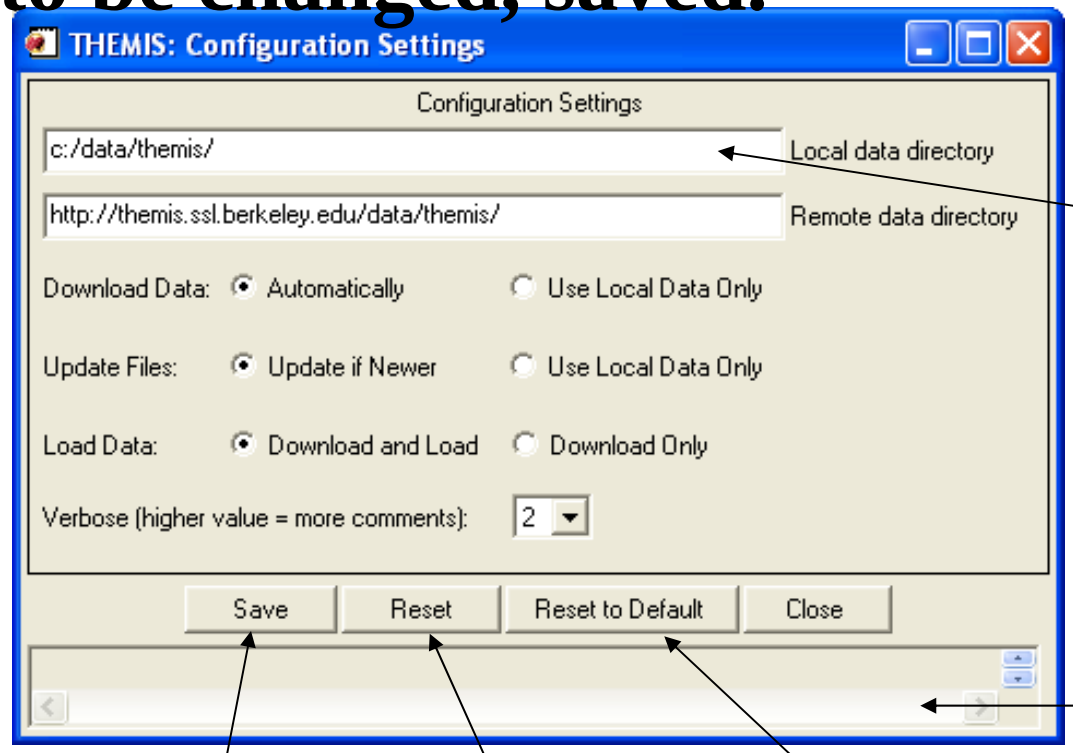
You can edit this form, and please save this and email it to:

THEMIS_Science_Support@ssl.berkeley.edu

Also email a saved history file and any other pertinent information that can be cut and pasted from the IDL window.



Configuration Settings: Allows configuration to be changed, saved.



You need to be able to write to this directory if you download data.

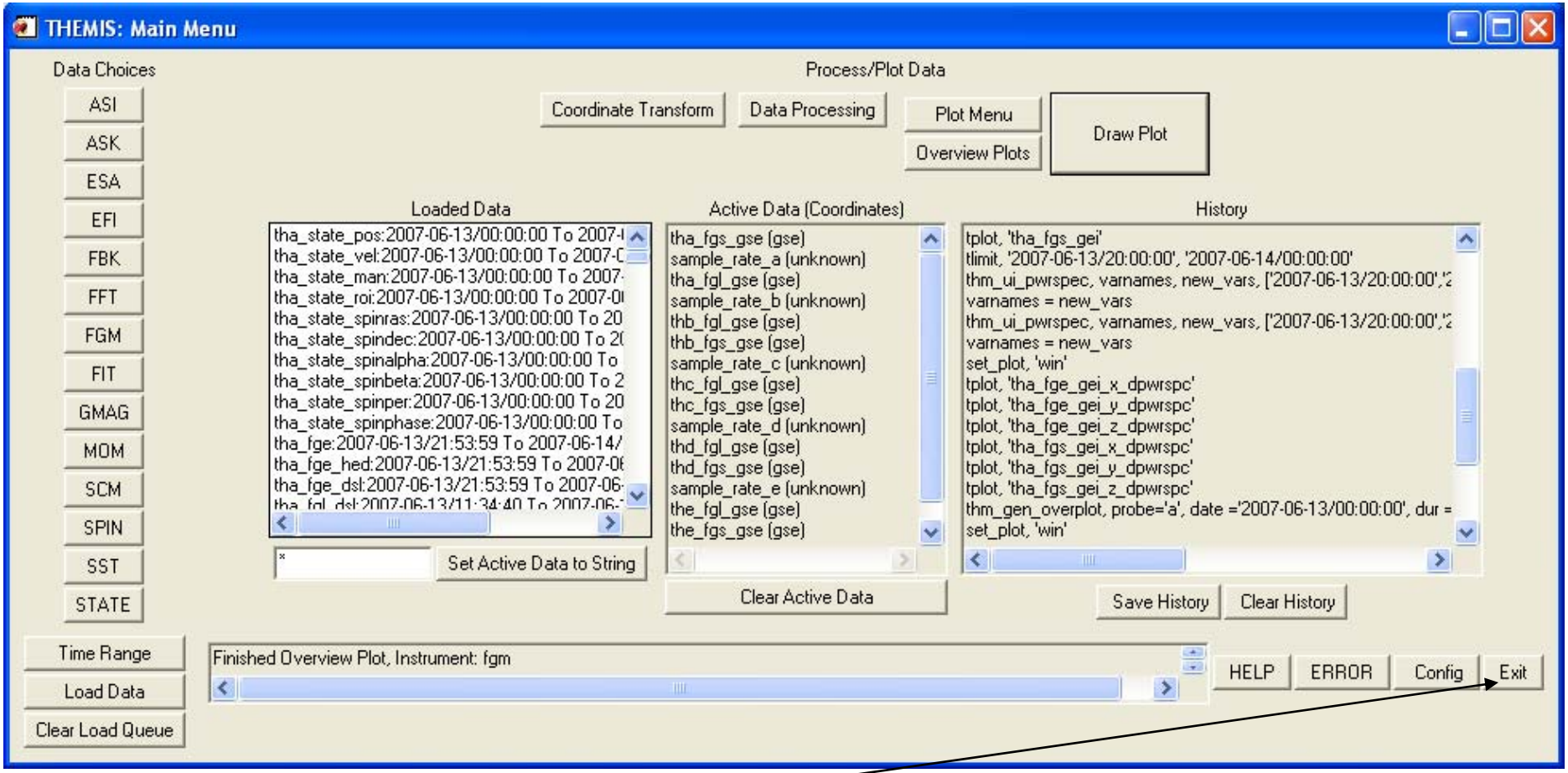
Messages

Saves in a file. Input into every session

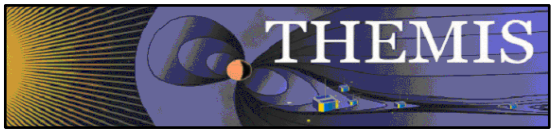
Resets to initial state.

Resets to default state in distribution, deletes any saved files.

Exit Button:



Click here to exit GUI. Popups are dismissed, except for Help, Error or Config and plot windows. Loaded data is not deleted and will show up in Loaded Data window on restart.



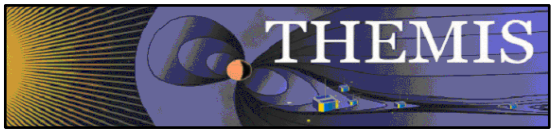
THM_GUI Tips:

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.

Always choose a time range before loading data. 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. If you try to load a relatively long time period, you will get a pop-up window that will ask you if you really want to do that.

The choice of "probe" in the data loading window 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.

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 window for guidance.



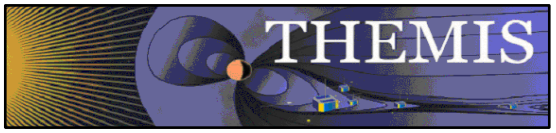
THM_GUI Tips:

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.

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.

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 window, and click "Delete".

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. Data Processing and Plotting tasks are only possible when there is "active" data.



THM_GUI Tips:

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 to see what you've typed.

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.

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...

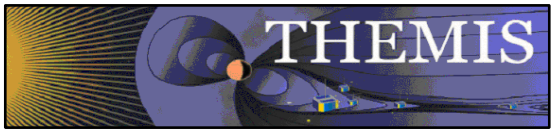
THM_GUI Tips:

The Plot Menu button may first issue a "tplot" call when the window pops up.

If you create a "PNG" plot, remember to reset to "SCREEN" for screen plotting.

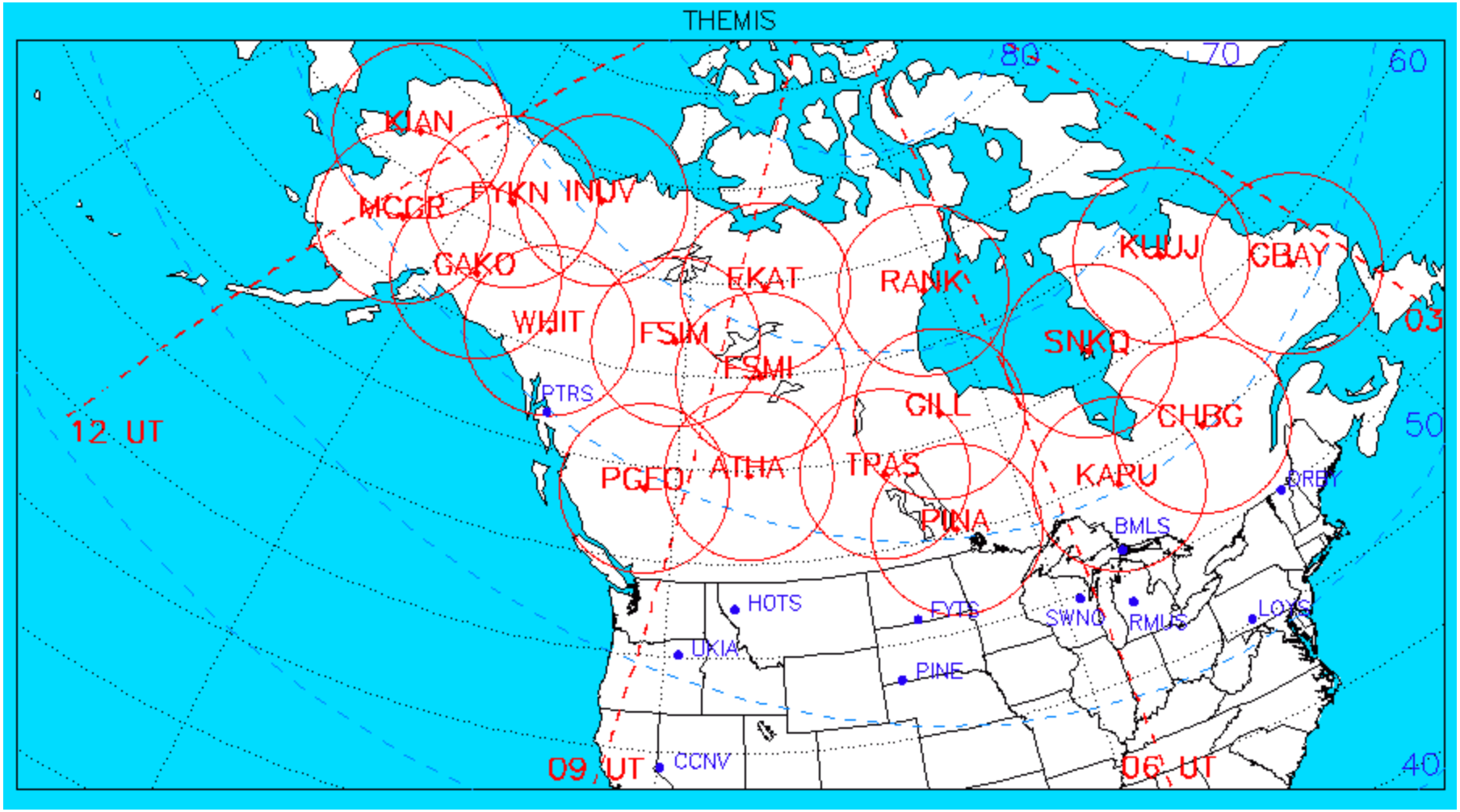
Don't try to plot more than about 10 quantities at a time, if there is spectrogram data, there will be a crash.

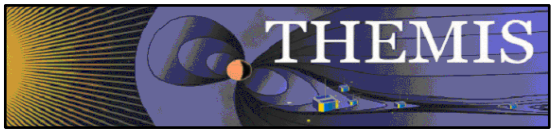
There will undoubtedly be more of these…



THEMIS software for GBO all-sky imager
Thm_crib_asi.pro
Harald U. Frey

THEMIS GBO network

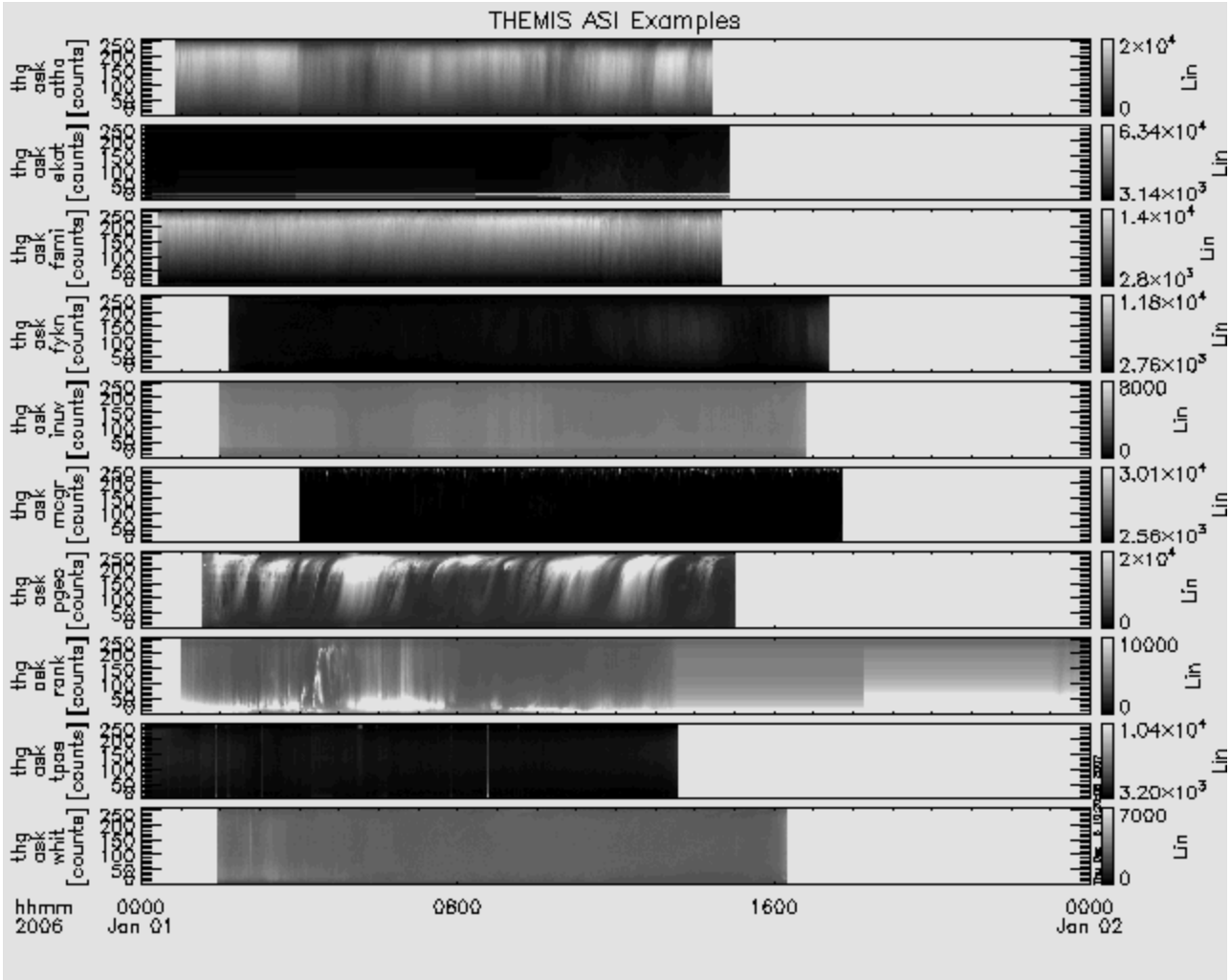




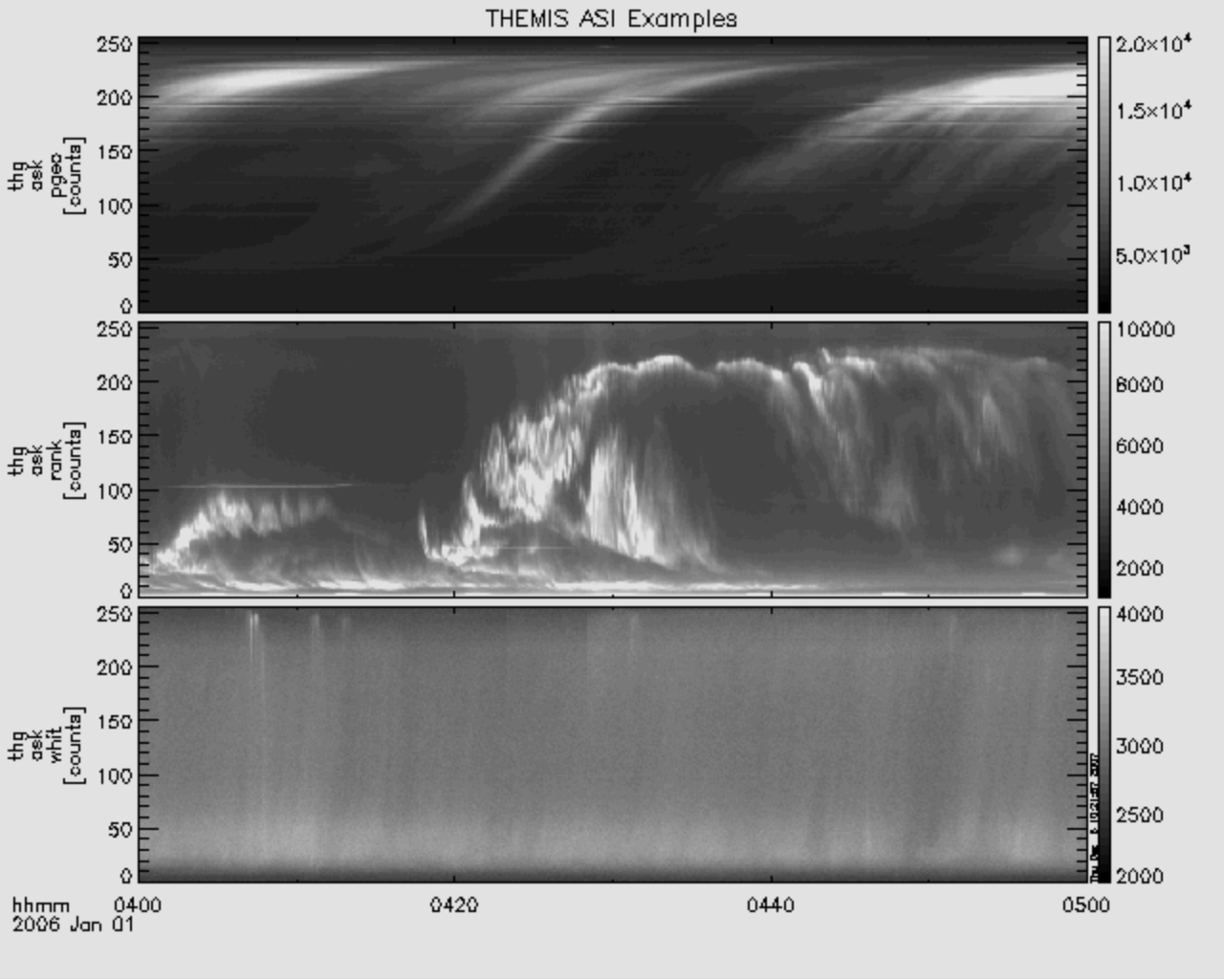
All-sky imager data products

1. Keograms along local magnetic meridian
   - Delivered daily jpeg-compressed
   - Reprocessed ½ year later with full resolution images
2. Geomagnetically mapped thumbnail images
   - Delivered daily square-root intensity compression
   - 1024 pixels within +-8^{o} magnetic Latitude and ~+-12^{o} Longitude
   - 3 seconds temporal resolution
3. Full resolution images
   - 256x256 pixels covering about 600 km radius around station
   - Delivered about ½ year later
   - 3 seconds temporal resolution
   - Full 16 bit intensity scale

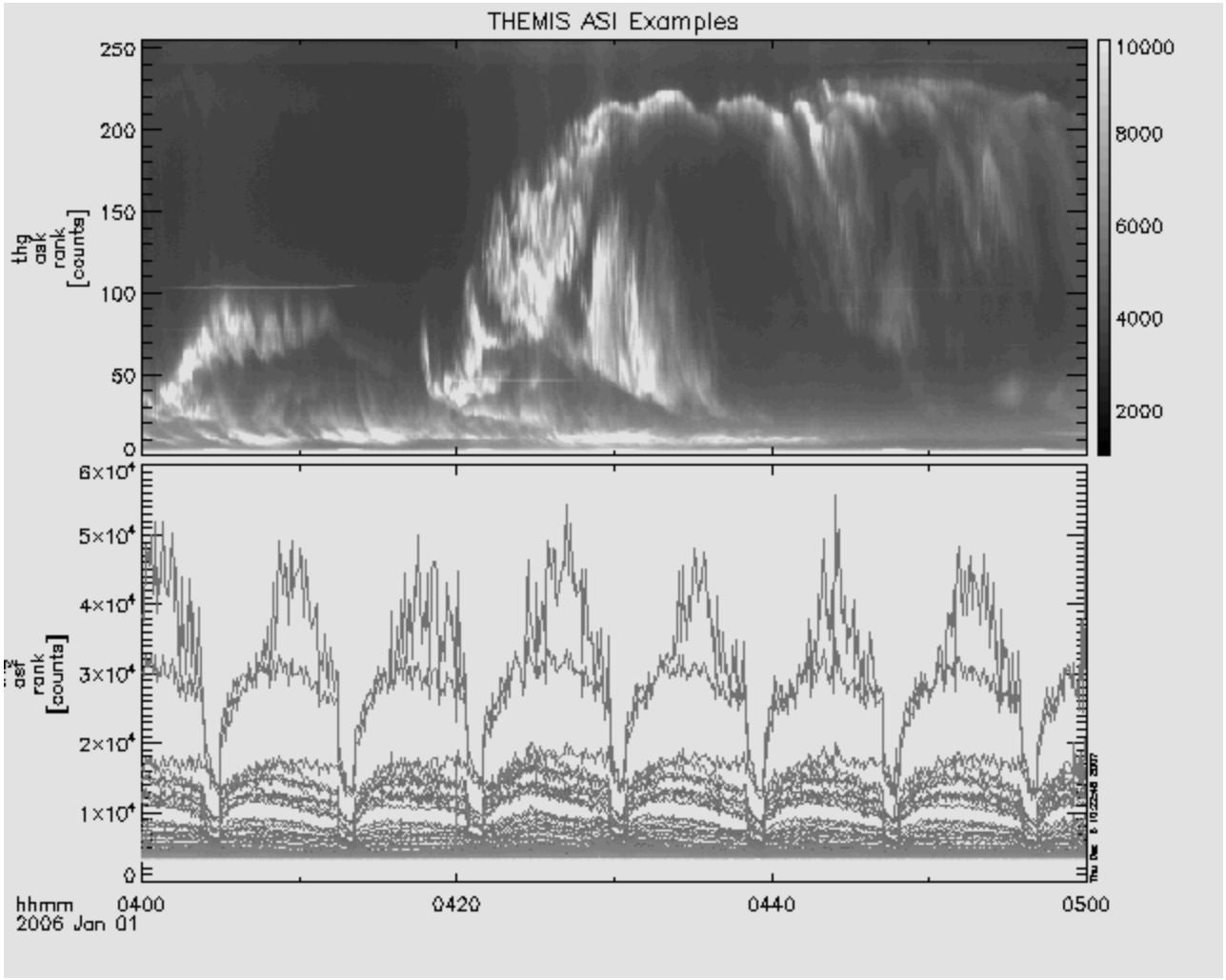
Daily overview of available keograms

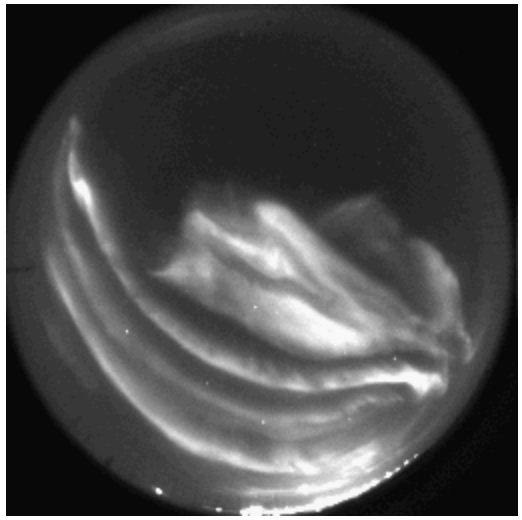


Zoom into interesting time

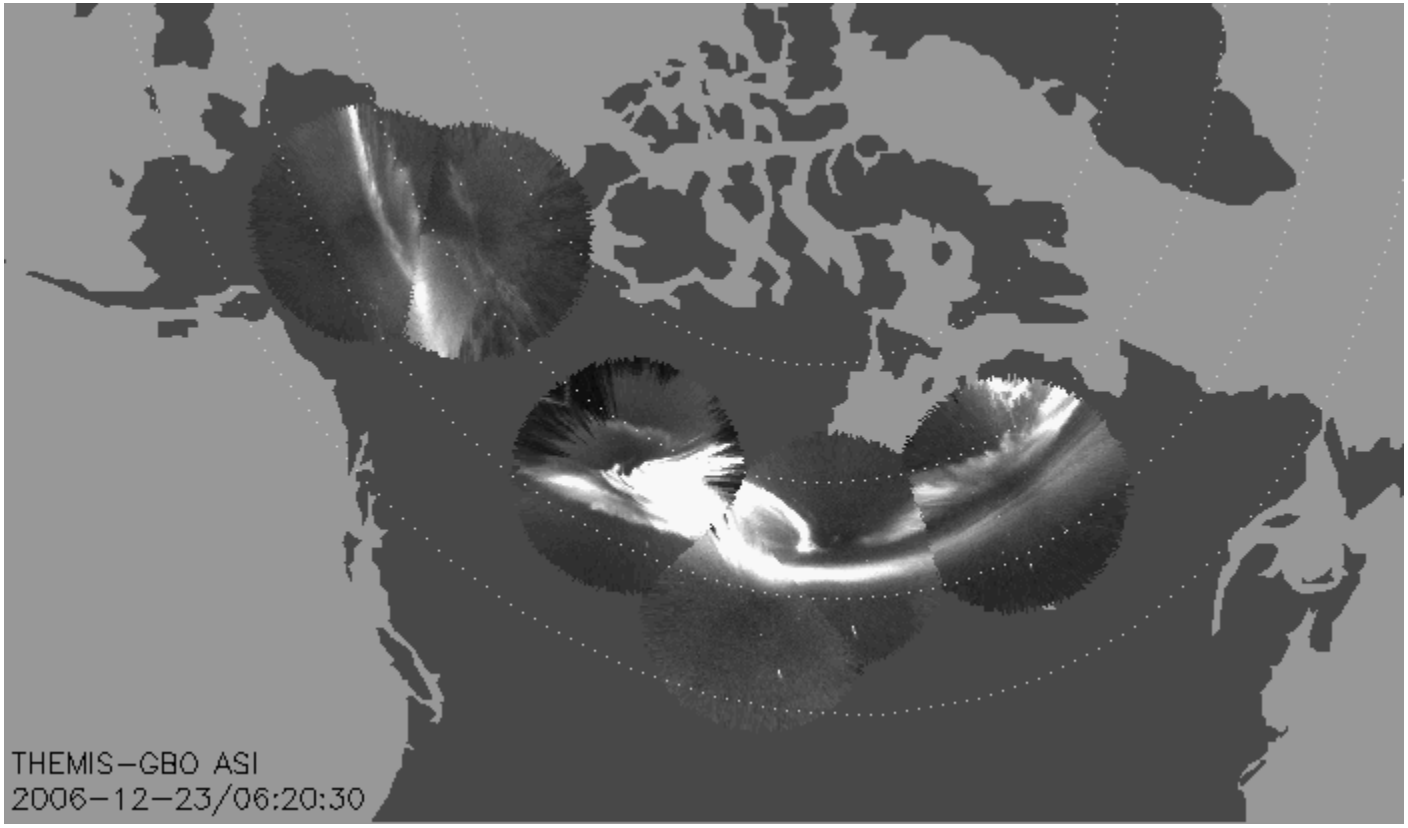


Watch “movie” of single station

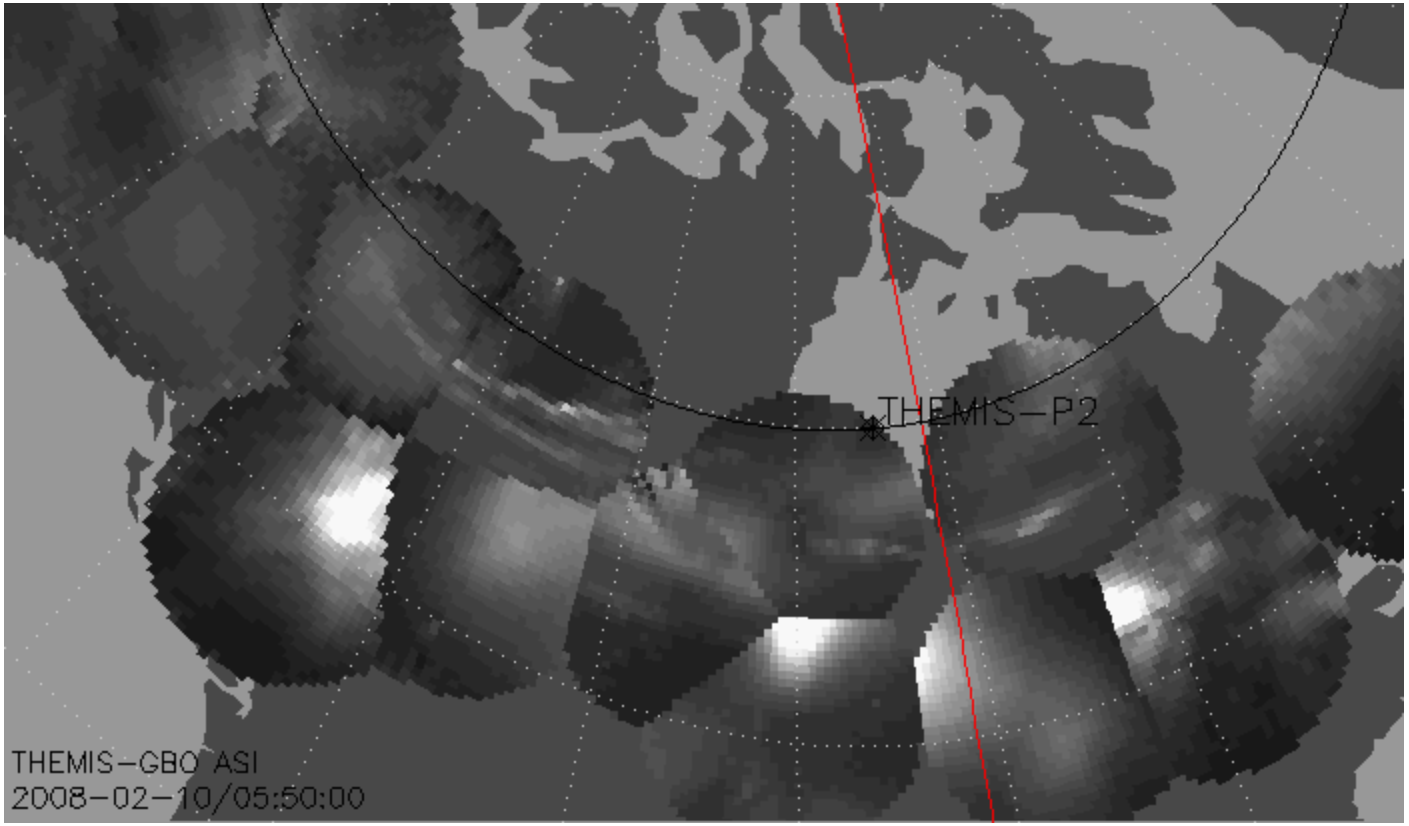




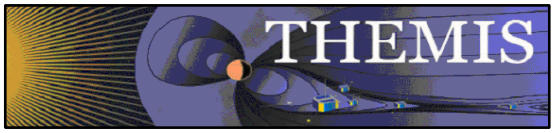
Mosaic of whole GBO array from full resolution images



Mosaic with S/C footprint From thumbnail images

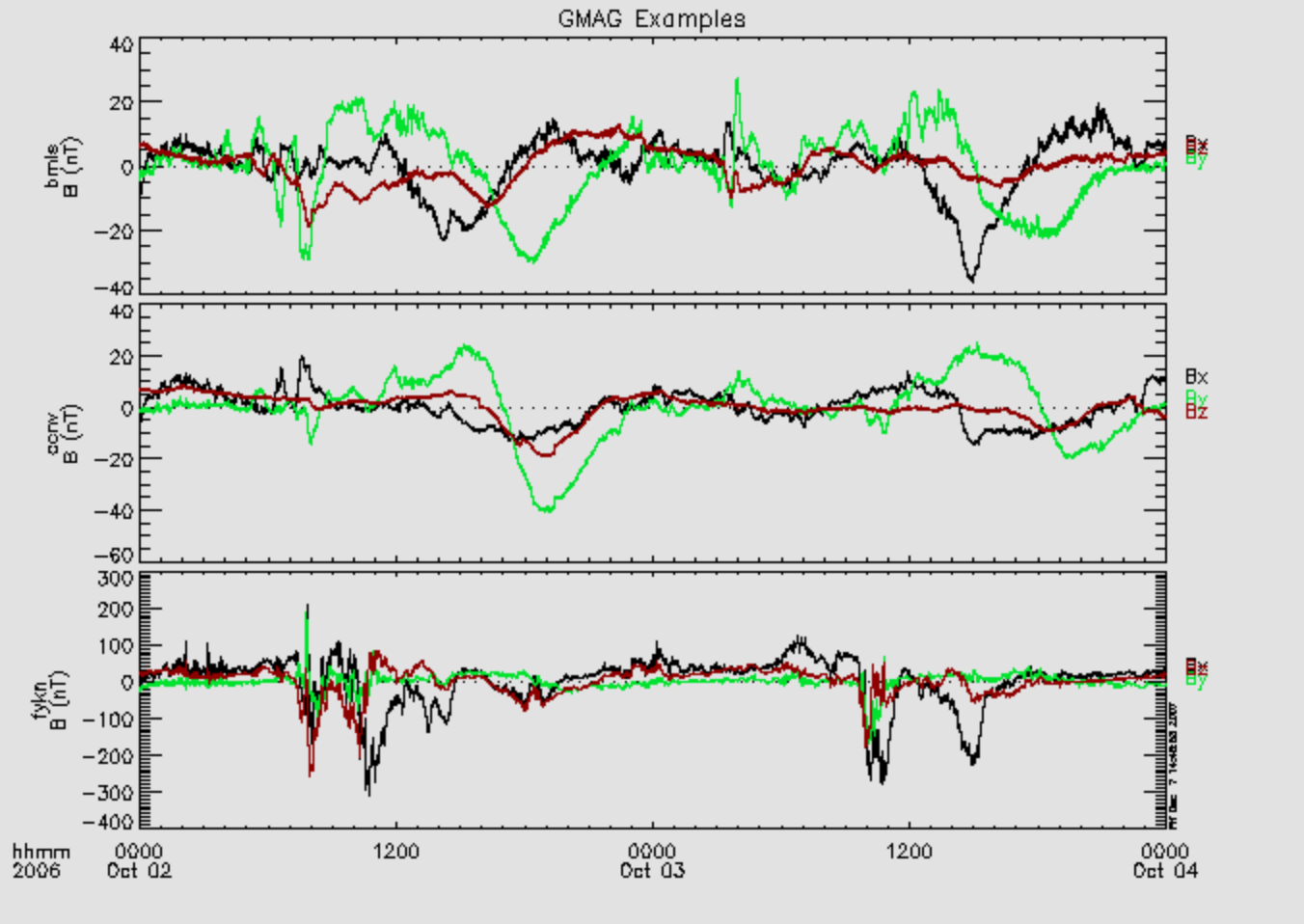


Black line marks footprint of THEMIS-P2 during whole night
Asterisk marks location at time of mosaic

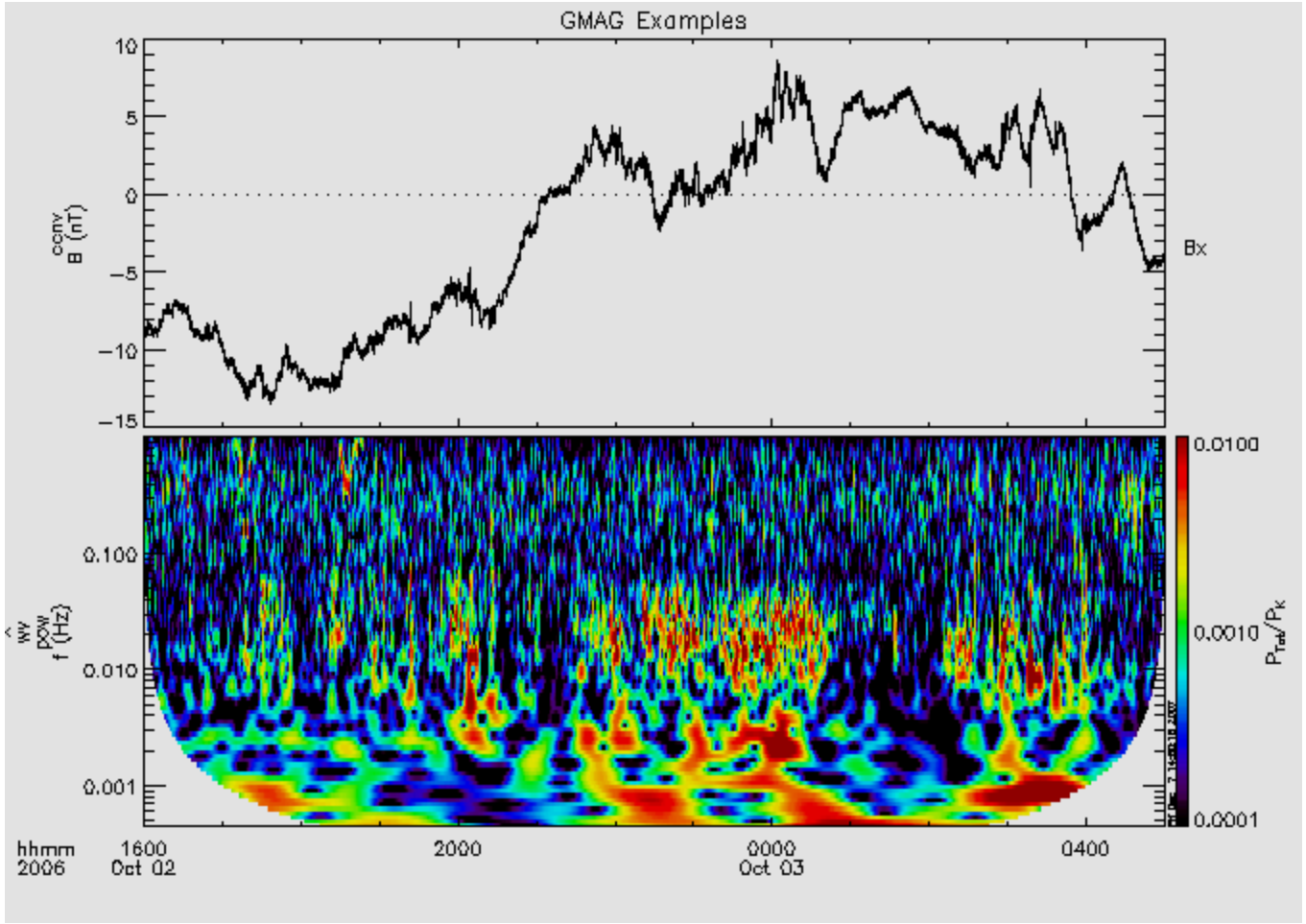


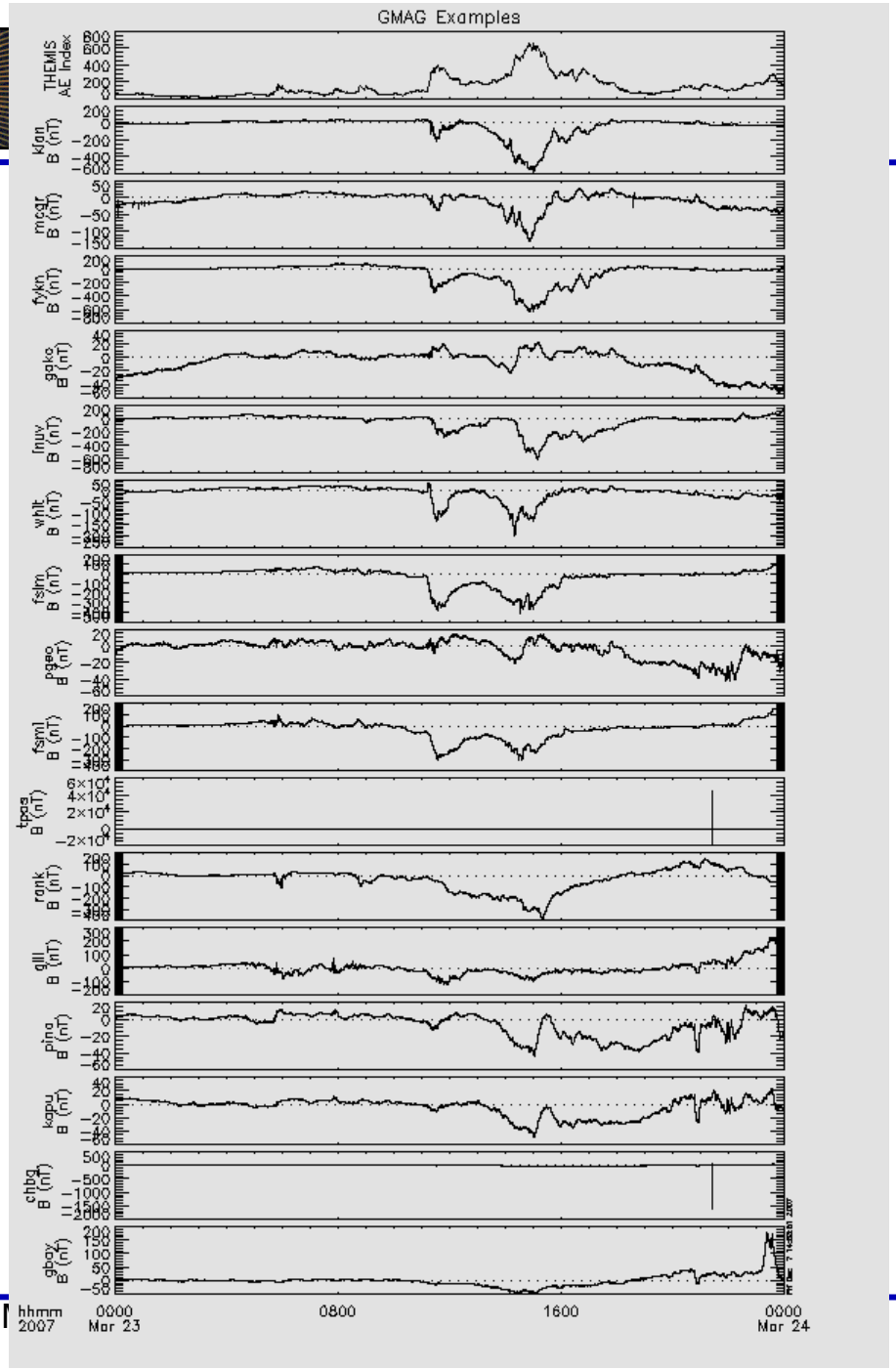
Ground magnetometer Examples
Thm_crib_gmag.pro

Three station example



Wavelet transform example





Pseudo-AE of network