SPEDAS Tutorial

GEM 2018, Santa Fe, NM

Agenda

SPEDAS Tutorial

Opening remarks

SPEDAS development status

New features, plugin status updates

Live demo: HAPI, Autoplot, GUI plot templates

Q&A, discussion

Space Physics Environment Data Analysis Software (SPEDAS)

- Grass-roots data analysis software for Space Physics Community
- SPEDAS is an outgrowth of THEMIS / ARTEMIS code that has been extended to support multiple missions
- Standardizes retrieval of data from distributed repositories
- Science processing and graphics contain powerful set of legacy routines.
- The THEMIS mission is now served through the TDAS plugin

The SPEDAS framework:

- Contains a GUI for ease of use (available through IDL VM freeware)
- Command line provides full access to IDL (paid license only)
- Works with Windows, Linux and Mac OS X.
- Is based on IDL, benefiting from platform independence and software maintenance services.

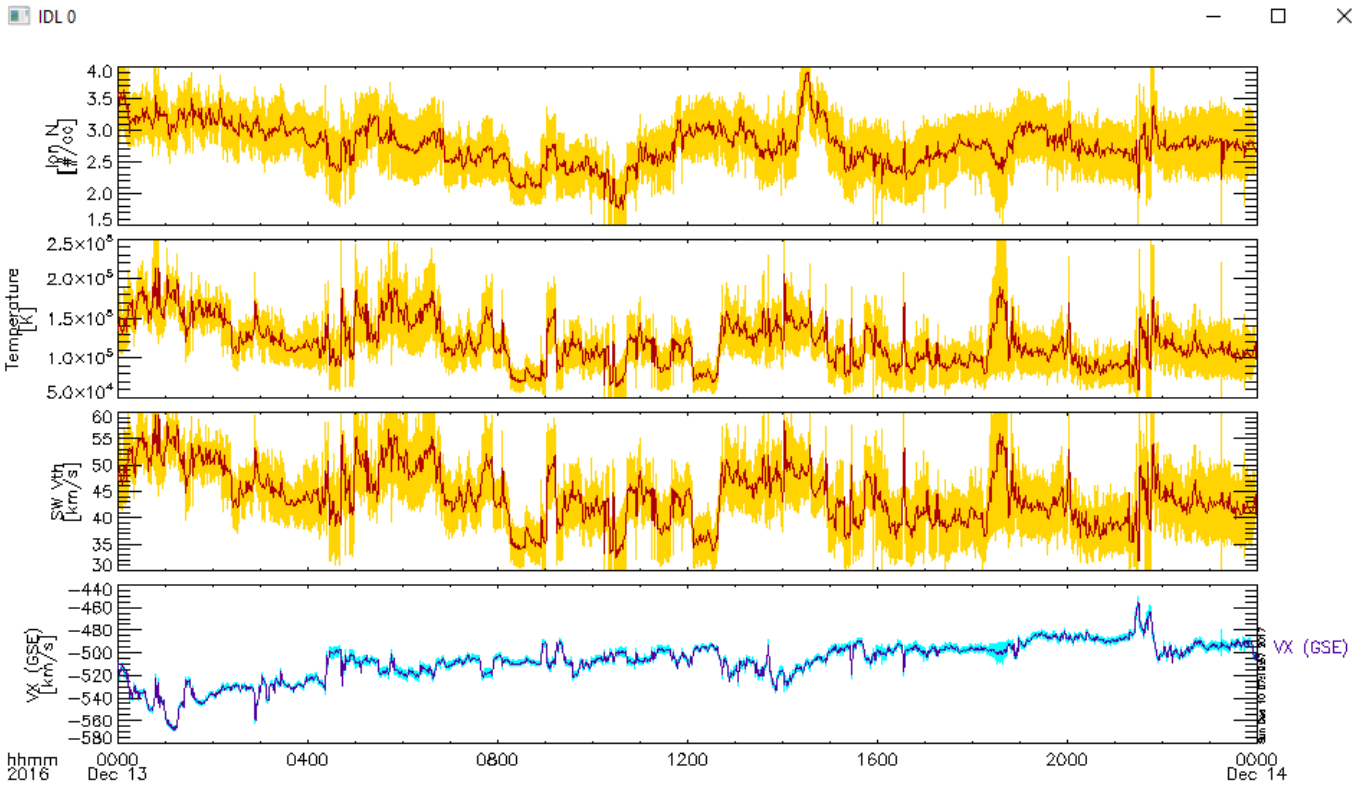
- What is the current status of SPEDAS development?
  - SPEDAS 3.0 was released in April, 2018, and includes these recently added features:
    - New plugin for Spherical Elementary Currents System (SECS) allows loading of EICS (Equivalent Ionospheric Currents) and SECA (SEC amplitudes) data, as well as plotting over THEMIS ASI mosaic maps.
    - New plugin for DSCOVR mission, including data loading, overview plots, and line plots with shaded confidence intervals.
    - Updates to ERG, IUGONET, THEMIS, and MMS plugins
    - Improved HTTPS support for digest authentication, and significant performance improvements when creating large numbers of new TPLOT variables.
    - Support for downloading data via the Heliophysics Application Program Interface (HAPI)
    - Preliminary support for exporting data from SPEDAS to Autoplot
    - Support for saving tplot variables as ISTP-compliant CDFs (tplot2cdf)

ERG (Arase) Project

Mariko Teramoto

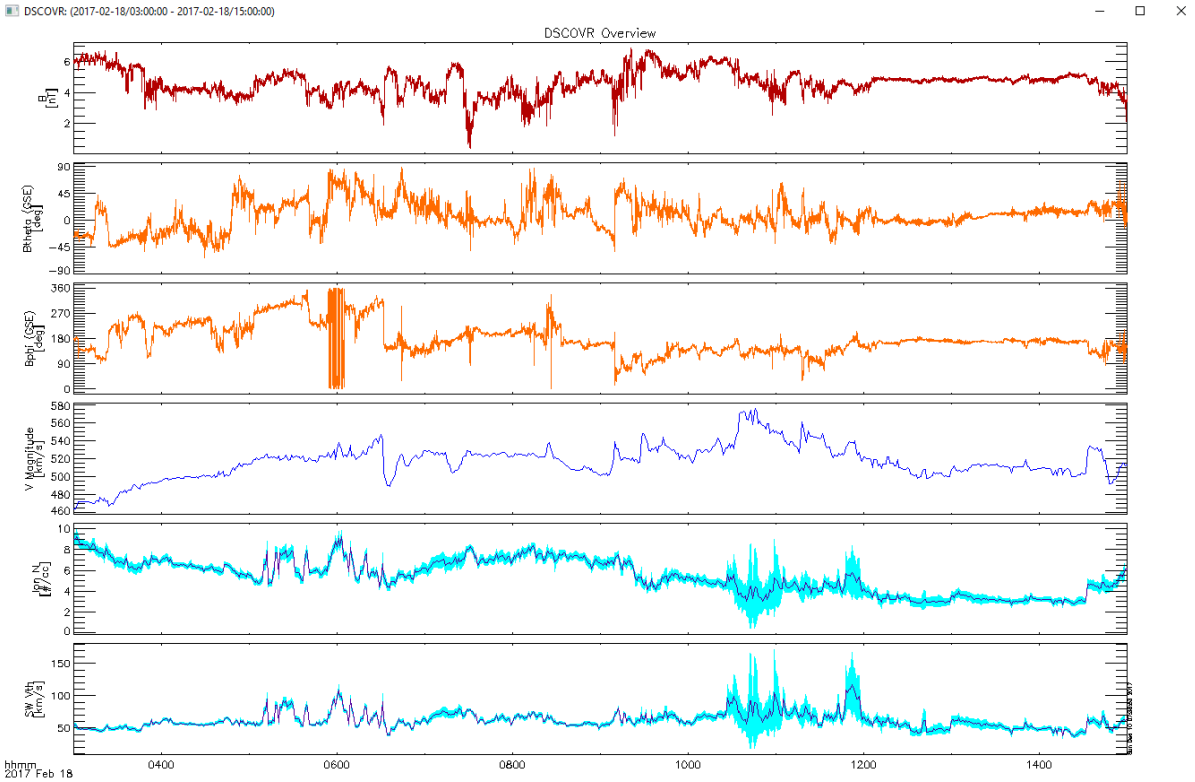
DSCOVR confidence interval plot, from projects/dscovr/examples/dsc_crib.pro:

```
tplot,
['dsc_h1_fc_Np','dsc_h1_fc_THERMAL_TEMP','dsc_h1_fc_THERMAL_SPD','dsc_h
1_fc_V_GSE_x'] ;aka [25,26,24,27]
dsc_dyplot
```

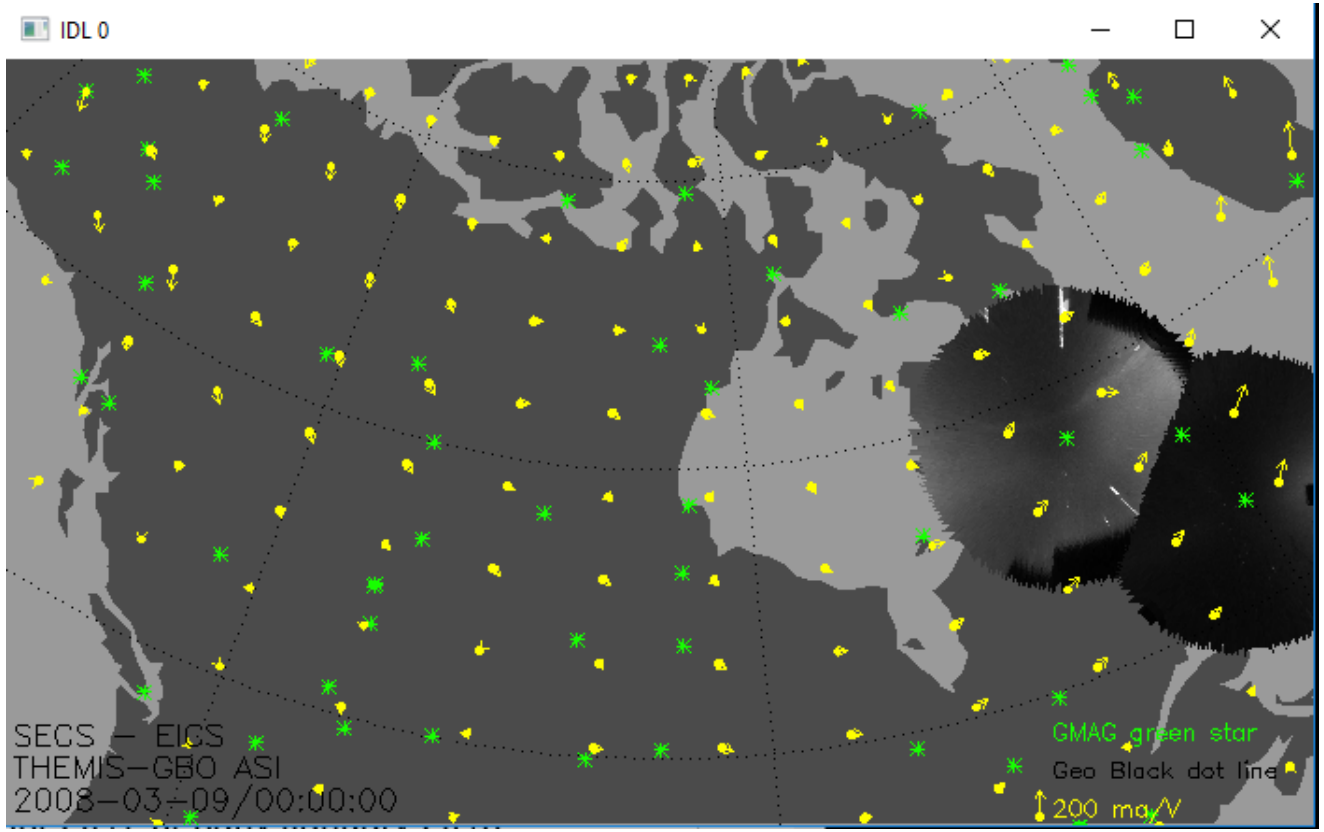


DSCOVR overview plot (dsc_crib.pro)

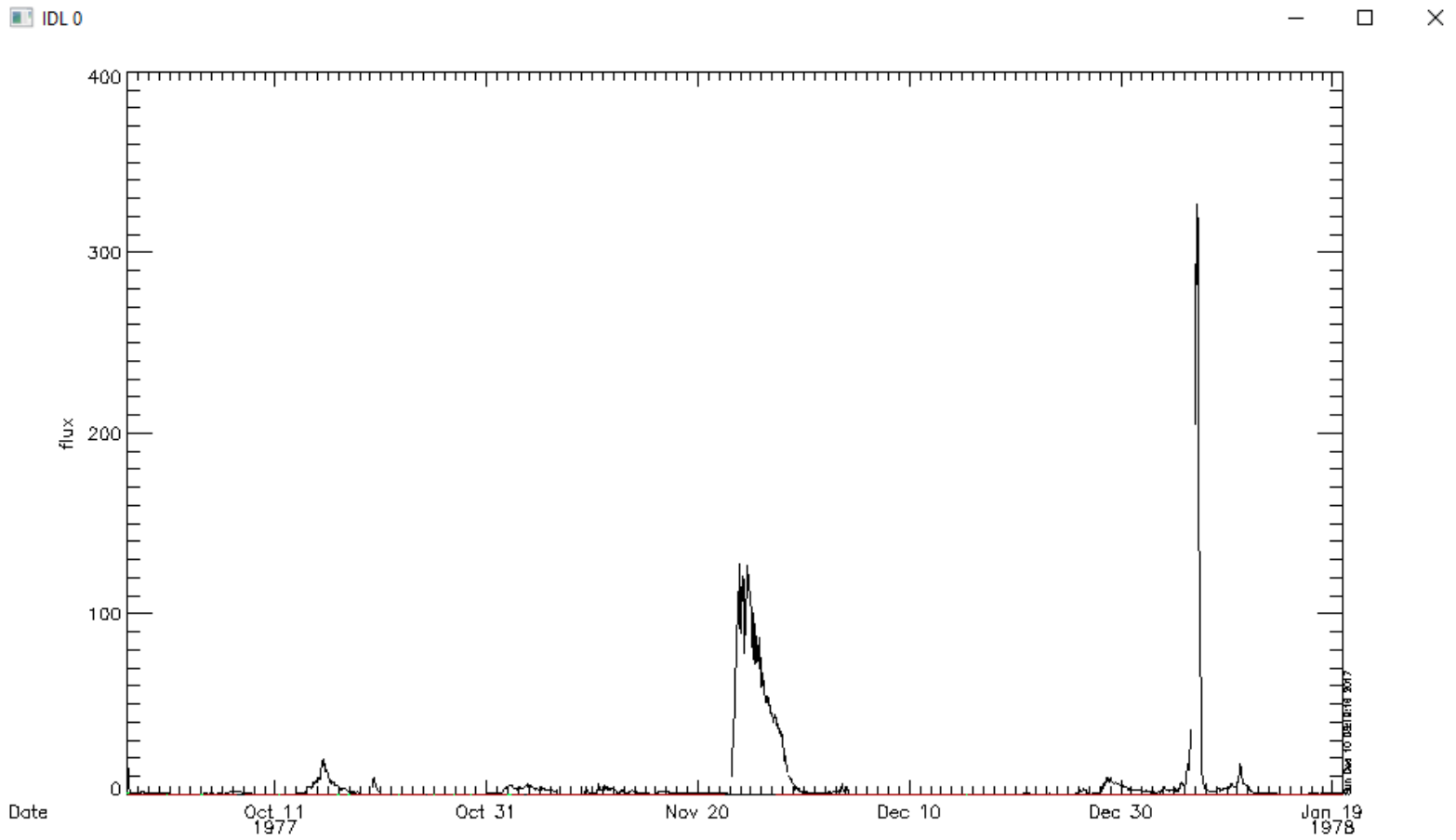
```
trg = timerange(['2017-02-18/03:00:00','2017-02-18/15:00:00'])
dsc_overview,trange=trg          ; Overview for a given timerange
dsc_overview_mag,trange=trg      ; Overview of Magnetometer data
dsc_overview_fc,trange=trg       ; Overview of Faraday Cup
data
```



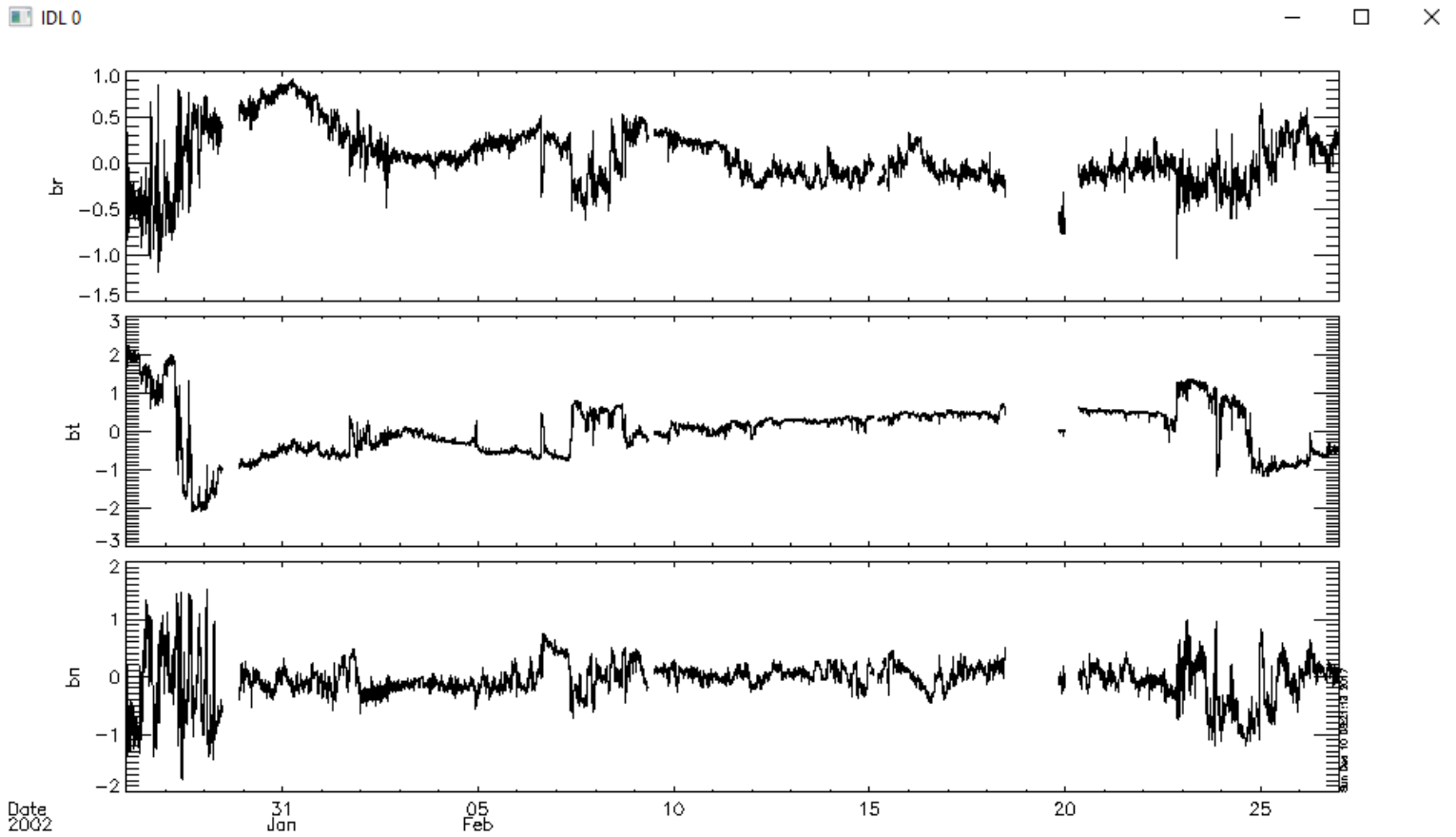
SECS ASI Mosaic plot (projects/secs/examples/ secs_mosaic_plot_crib)

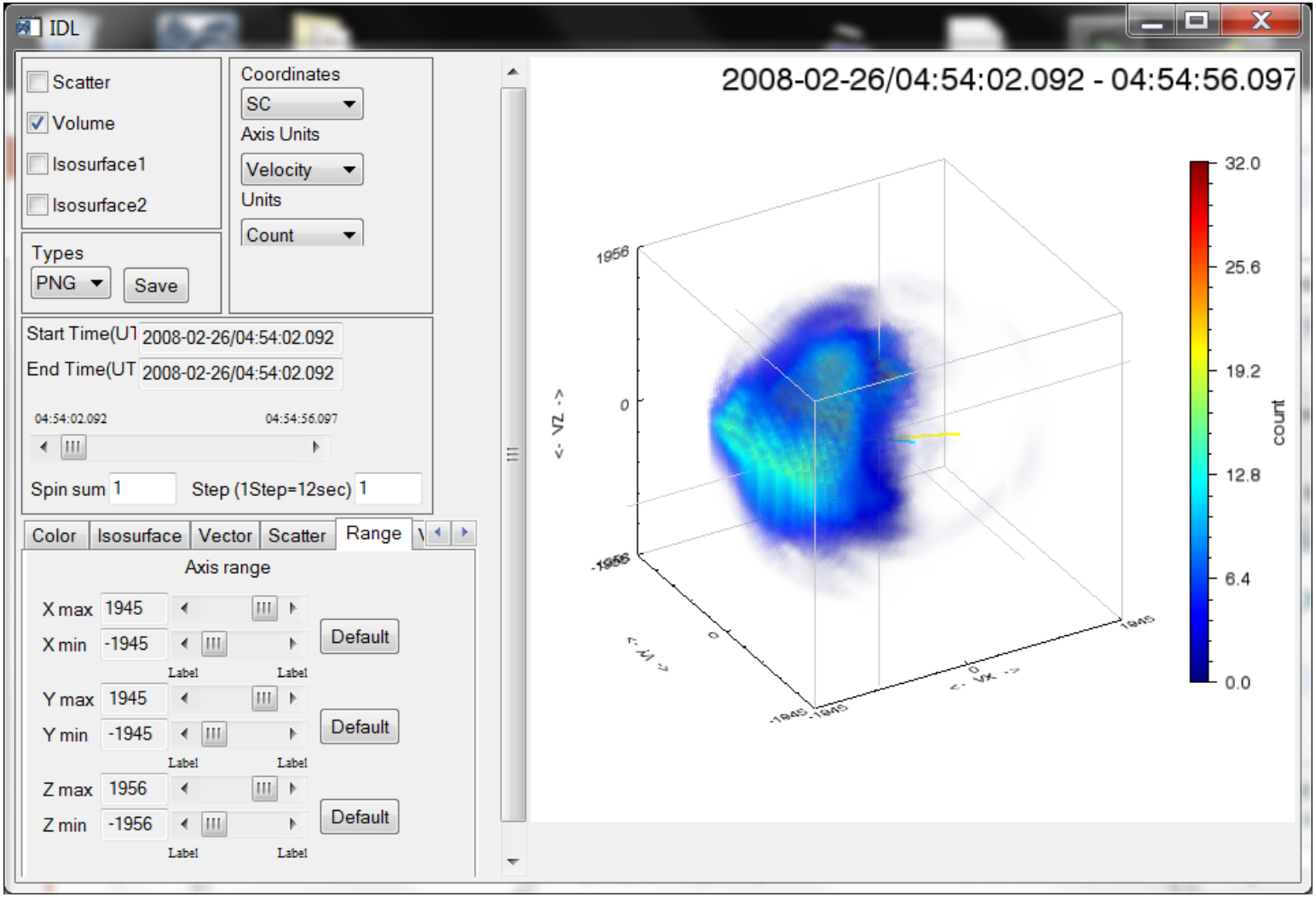


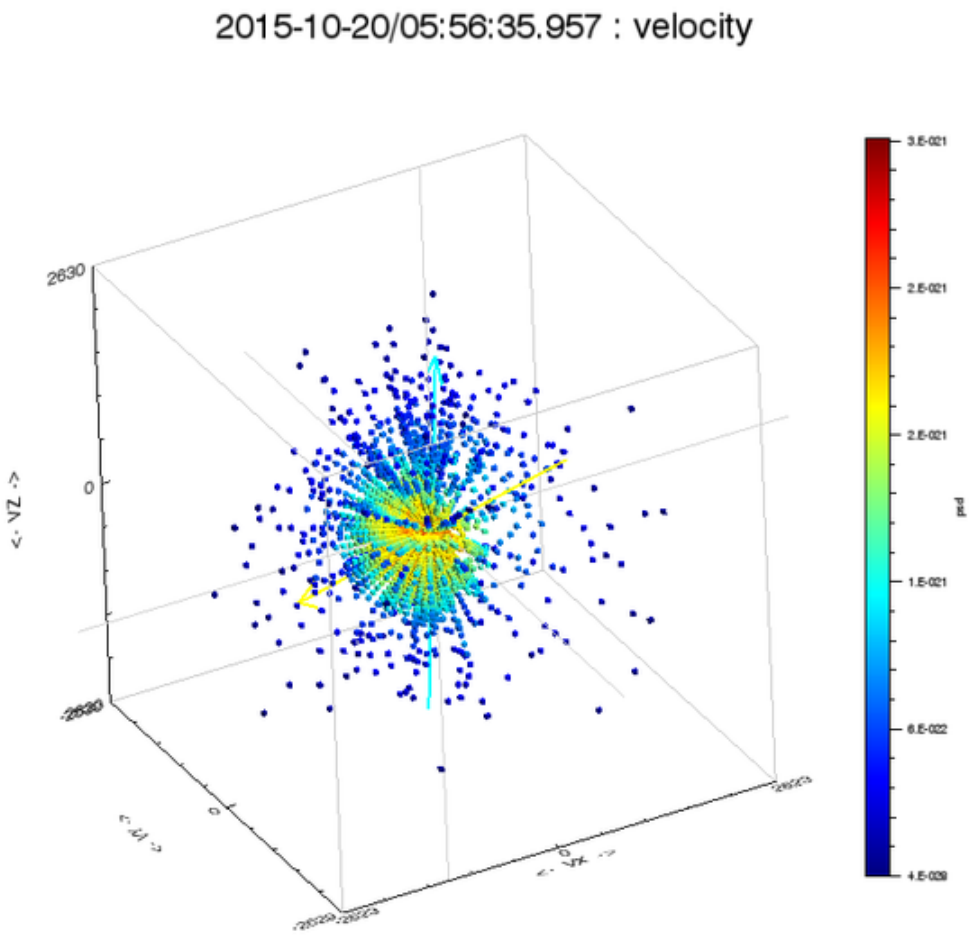
Voyager 1 proton flux via Heliophysics API (HAPI), from idl/general/crib_hapi.pro:

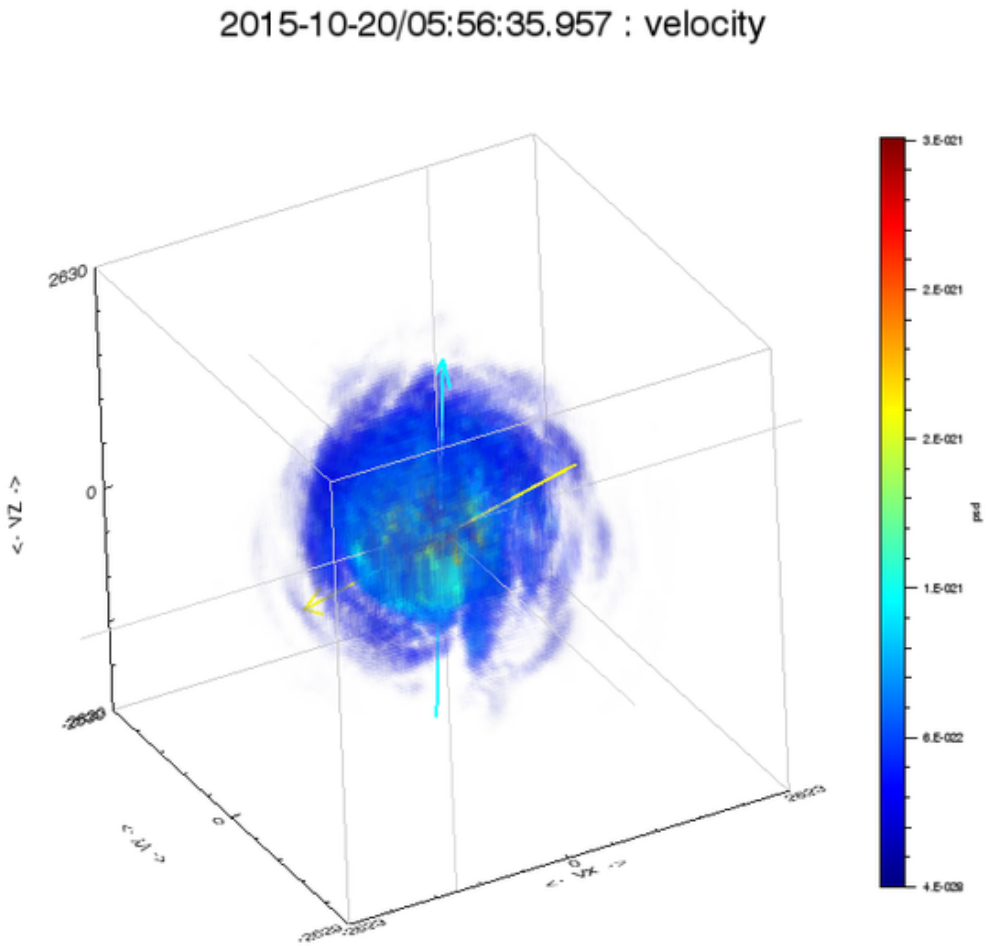


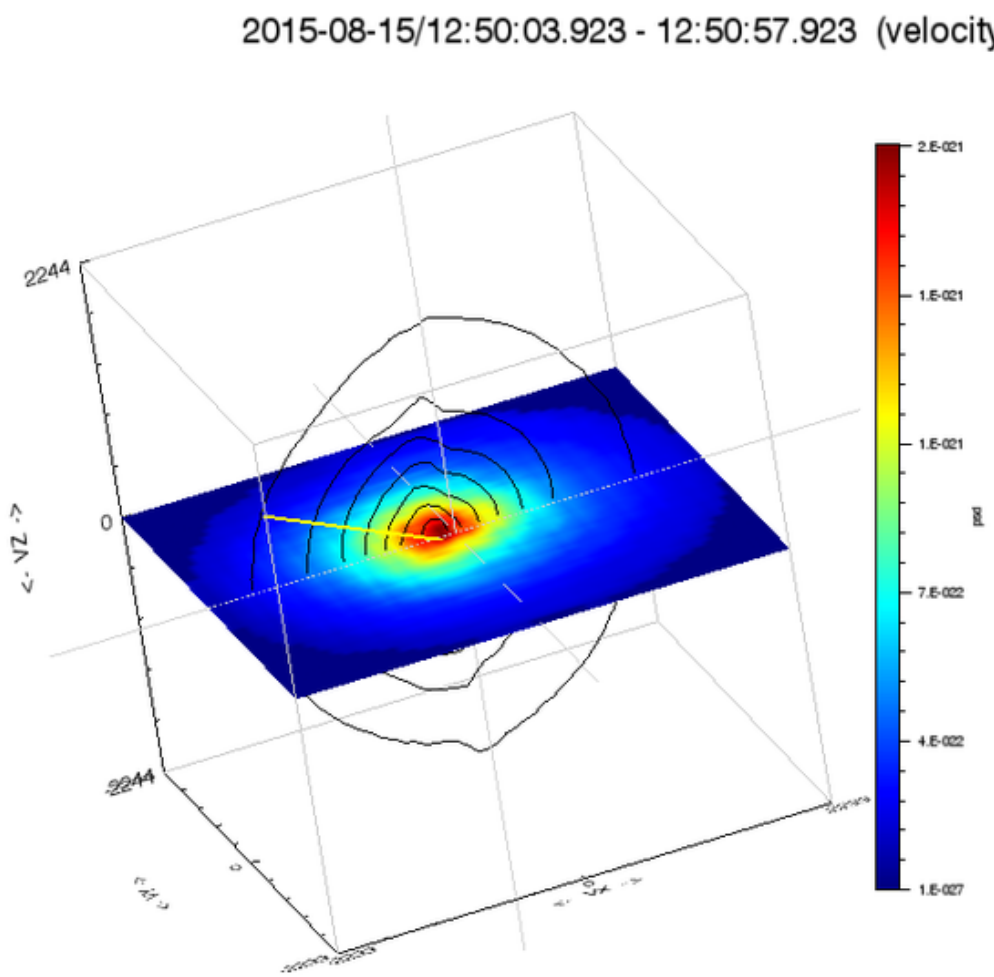
Cassini mag data via Heliophysics API (HAPI), from idl/general/crib_hapi.pro:




IDL
Scatter
Volume
Isosurface1
Isosurface2
Coordinates
SC
Axis Units
Velocity
Units
Count
Types
PNG
Save
Start Time(UT
2008-02-26/04:54:02.092
End Time(UT
2008-02-26/04:54:02.092
04:54:02.092
04:54:56.097
Spin sum 1
Step (1Step=12sec) 1
Color
Isosurface
Vector
Scatter
Range
Axis range
X max 1945
X min -1945
Y max 1945
Y min -1945
Z max 1956
Z min -1956
Label
Default
2008-02-26/04:54:02.092 - 04:54:56.097
32.0
25.6
19.2
12.8
6.4
0.0
count
1956
0
-1956
<- VZ ->
<- VY ->
<- VX ->


2015-10-20/05:56:35.957 : velocity
2630
0
-2630
<- VZ ->
<- VY ->
<- VX ->
3.E-021
2.E-021
2.E-021
1.E-021
6.E-022
4.E-029
psd

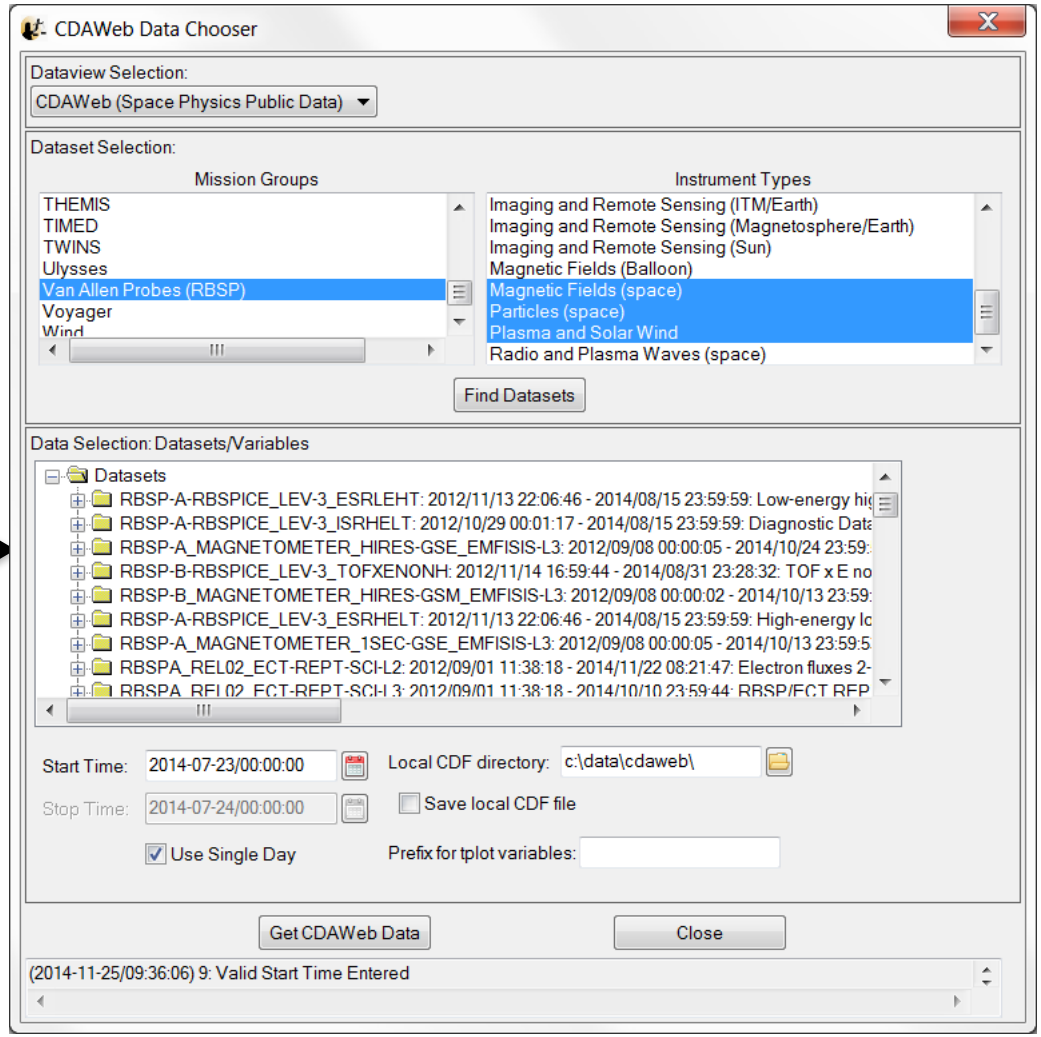

2015-10-20/05:56:35.957 : velocity
2630
0
-2630
<- VZ ->
<- VY ->
<- VX ->
3.E-021
2.E-021
2.E-021
1.E-021
6.E-022
4.E-029
psd


2015-08-15/12:50:03.923 - 12:50:57.923 (velocity)
2244
0
2244
2.E-021
1.E-021
1.E-021
7.E-022
4.E-022
1.E-027

Loading CDAWeb Data

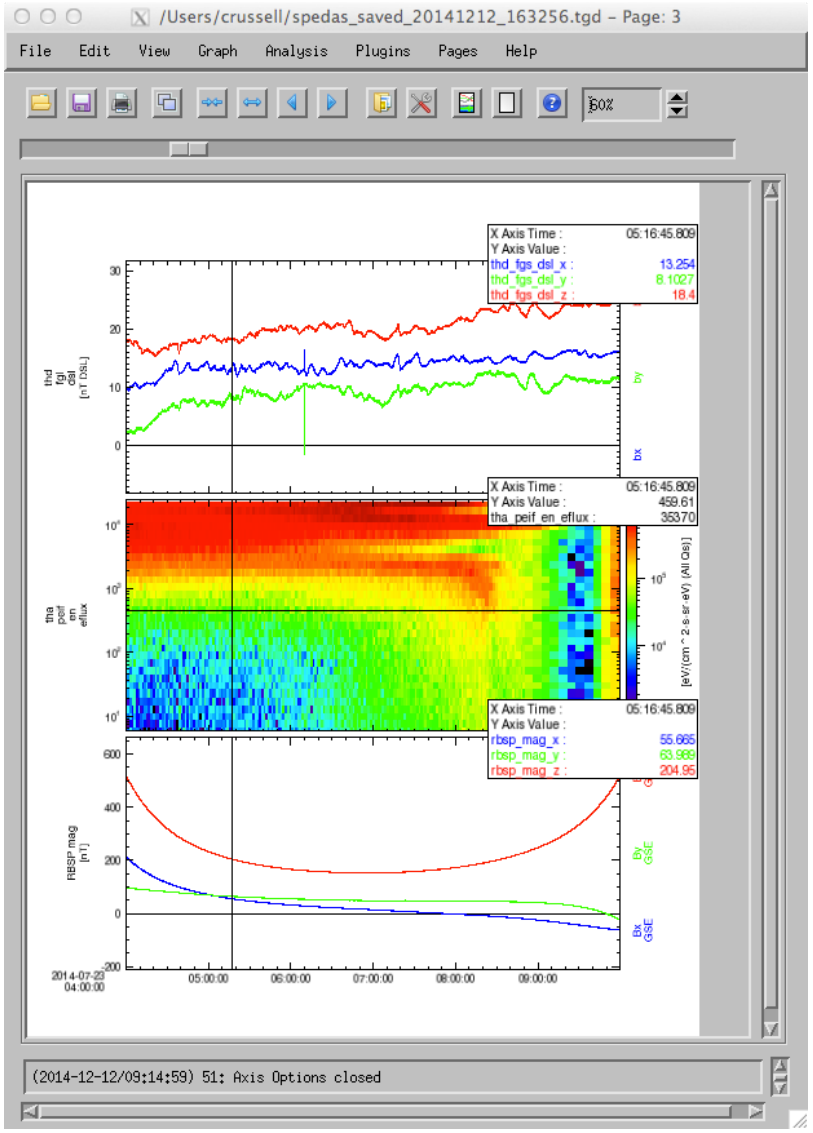
To Load **CDAWeb Data**:

-Select 'Load Data using CDAWeb' under the File menu
- Select Mission Group (i.e., TWINS, Cluster, RBSP, etc.)
- Select the Instrument Type
- Click 'Find Datasets'
- Select variable or dataset to download
- Click 'Get CDAWeb Data'



THEMIS and RBSP Plots

- With a few clicks of the button the user can load, analyze, and plot data.
- Interactive Capabilities



SPEDAS Mini Language

- Simple scripting language has been written in IDL.
- This language allows access to some data analysis functionality in the IDL virtual machine and eases manipulations of time series (tplot) data
- This language allows composition of statements and functions with order of operations to give significant flexibility in statement construction

Examples:

1: Position to RE:

calc,'"tha_pos_re" = "tha_state_pos"/6374.4'

2: Natural log of total esa density:

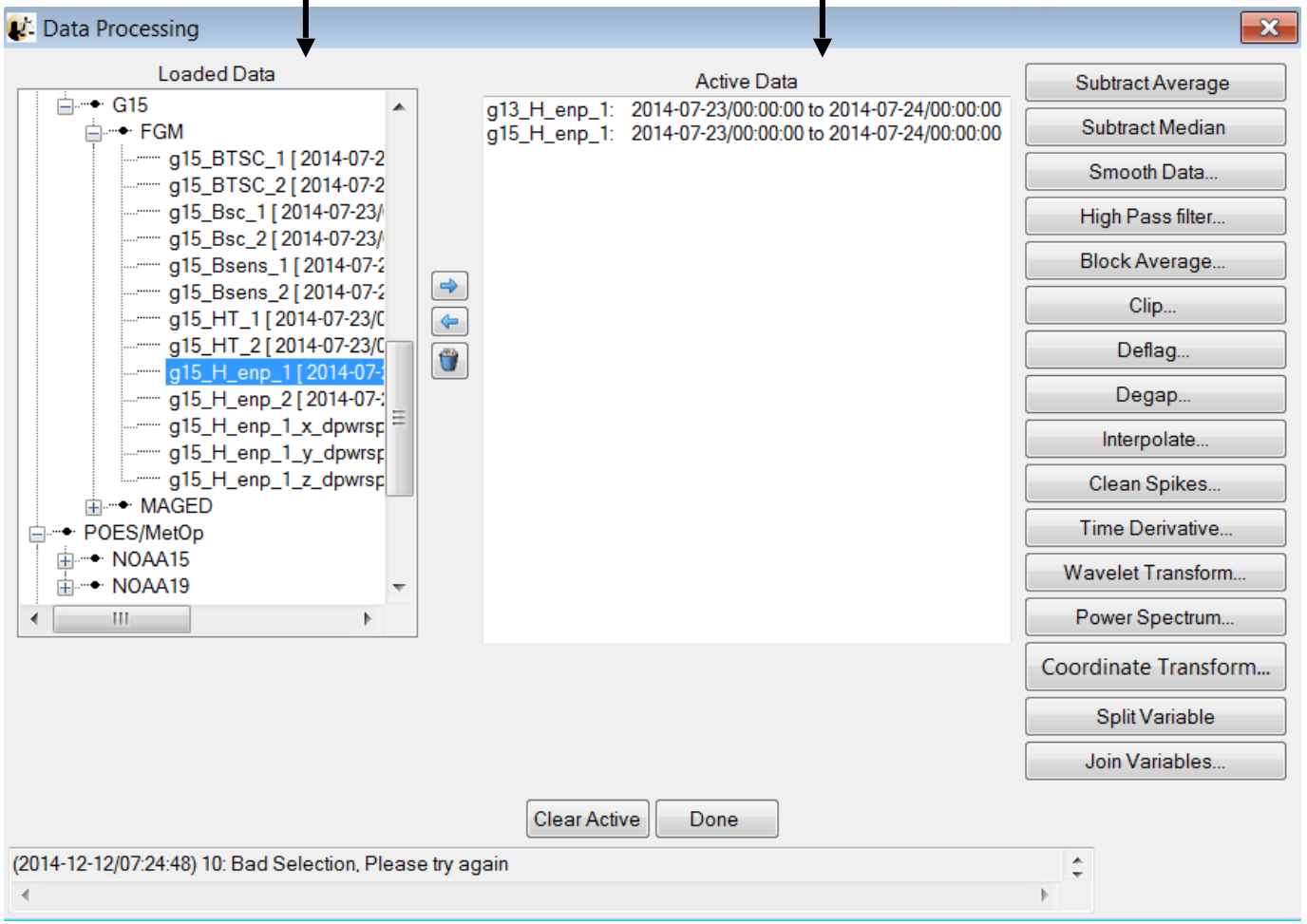
calc,'"tha_density_log"
=ln("tha_peir_density"+"tha_psif_density")

3: Average magnetic pressure:

calc,'Pb_avg = mean(0.01*total("tha_fgs_dsl"^2,2)/25.132741)'

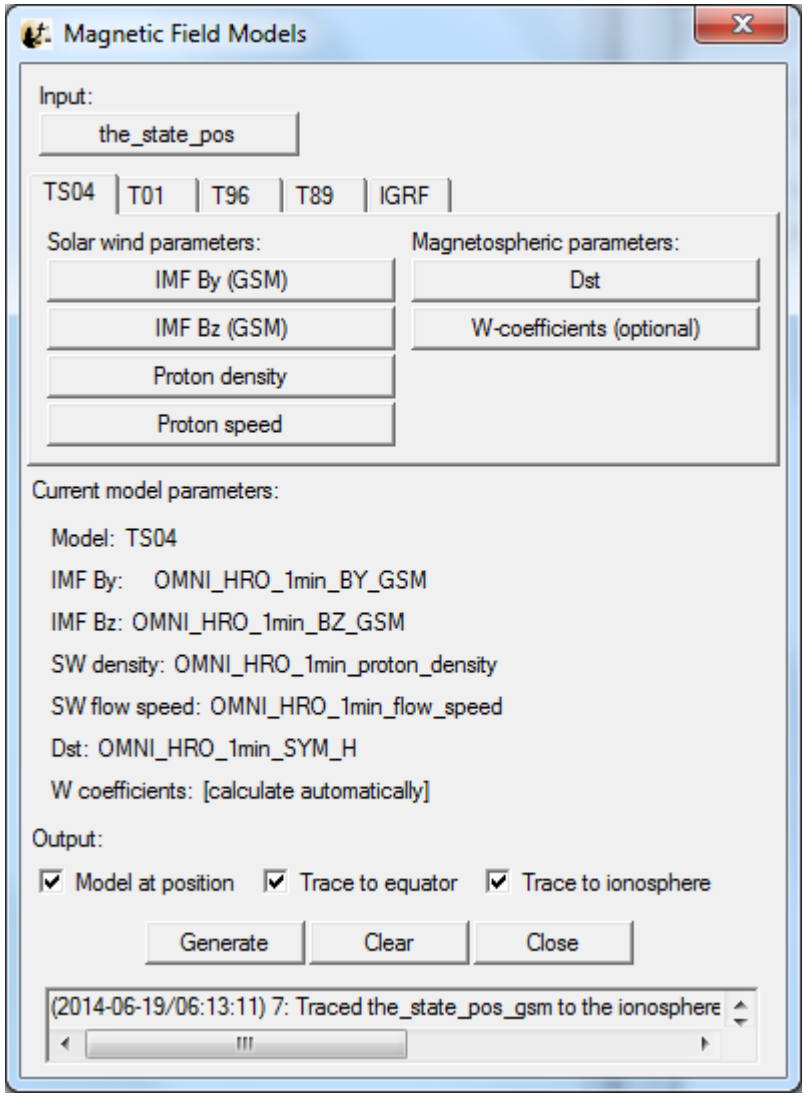
Additional examples can be found in general/examples/crib_calc.pro

Data Analysis

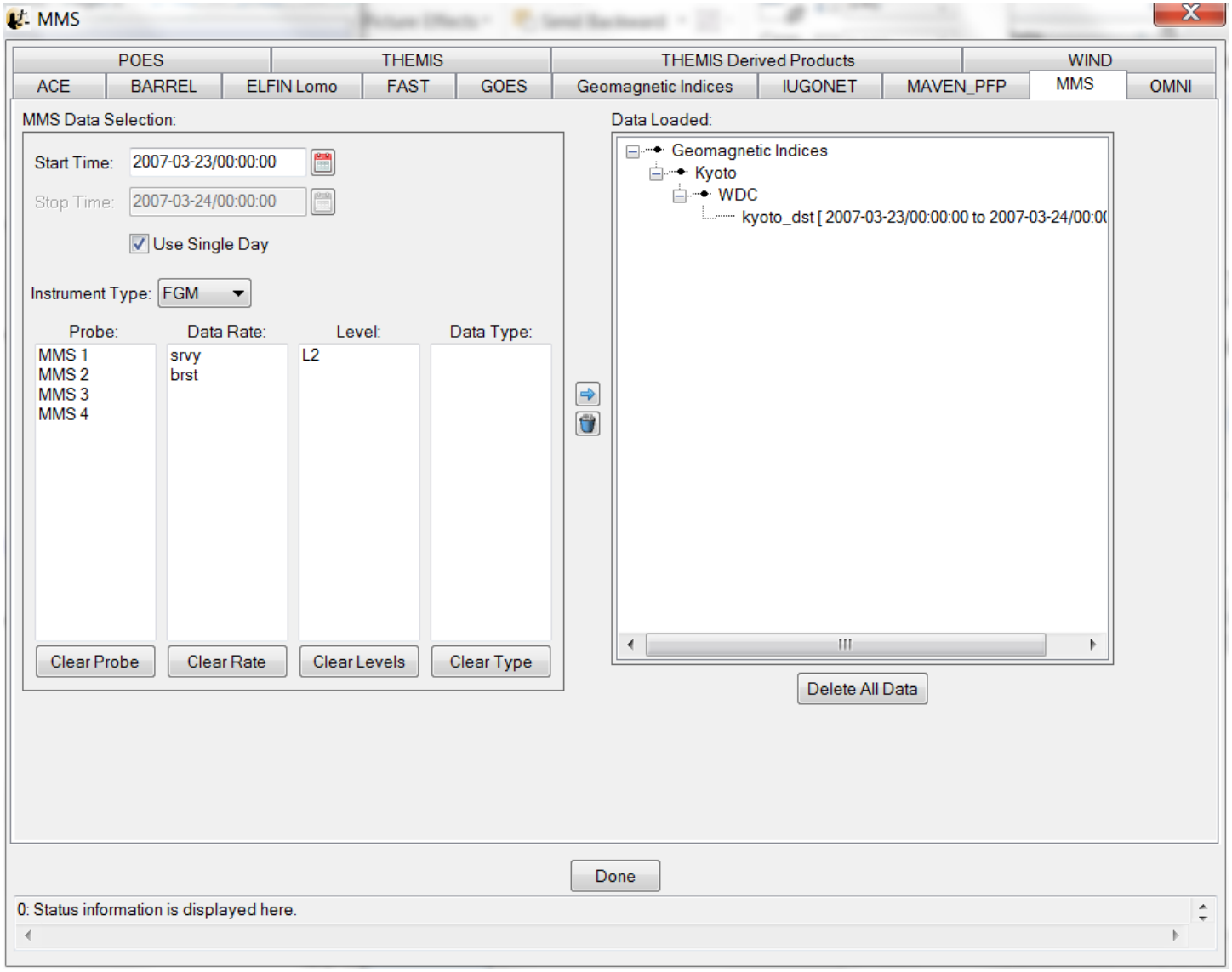


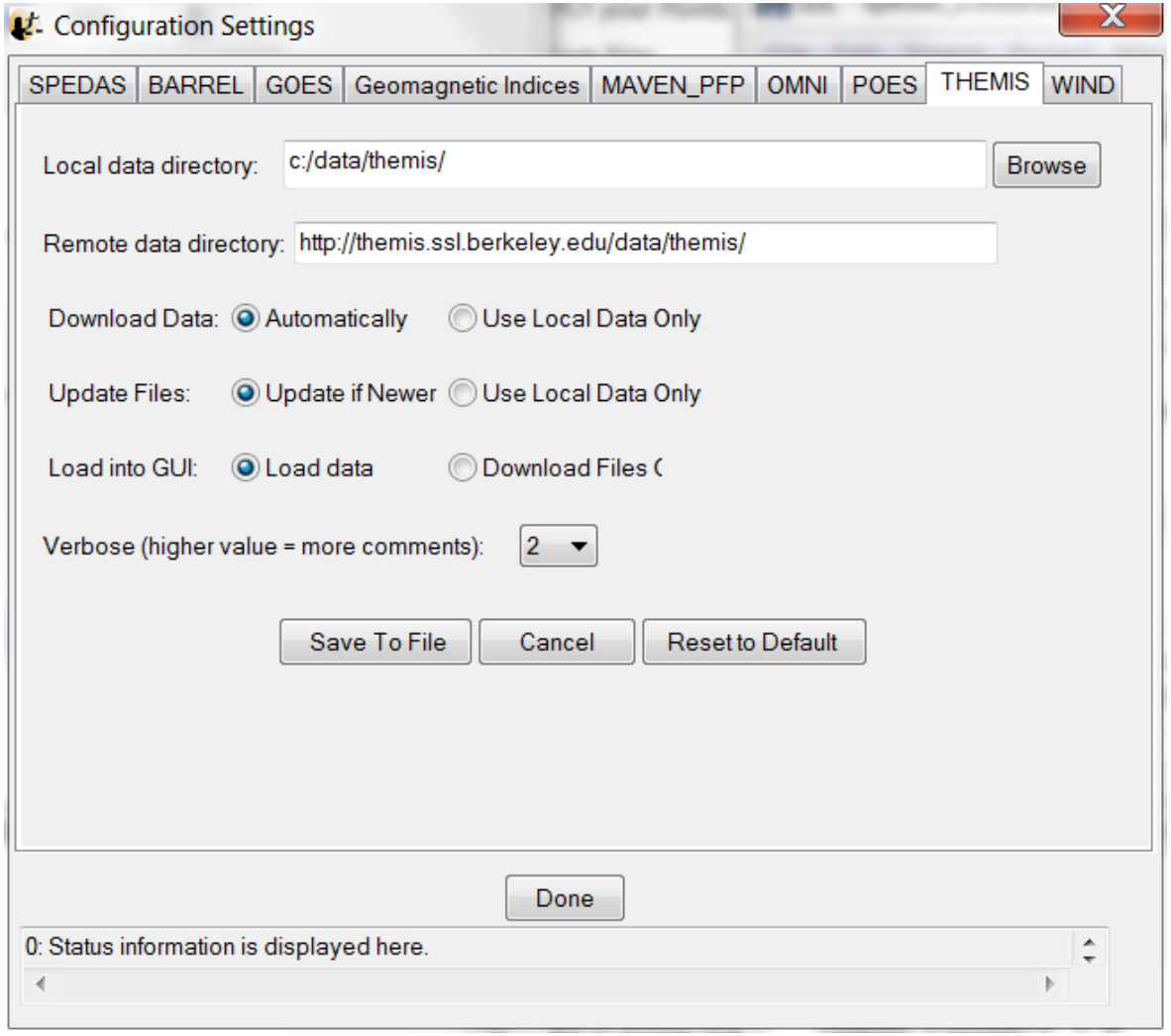
Magnetic Field Models

The GUI is now able to:
- Model the field at the spacecraft position
- Trace field from position to the ionosphere and equator



Load Data panel (MMS plugin tab)




Configuration Settings
SPEDAS
BARREL
GOES
Geomagnetic Indices
MAVEN_PFP
OMNI
POES
THEMIS
WIND
Local data directory:
c:/data/themis/
Browse
Remote data directory:
http://themis.ssl.berkeley.edu/data/themis/
Download Data:
Automatically
Use Local Data Only
Update Files:
Update if Newer
Use Local Data Only
Load into GUI:
Load data
Download Files (
Verbose (higher value = more comments):
2
Save To File
Cancel
Reset to Default
Done
0: Status information is displayed here.

- SPEDAS Development Roadmap
  - SPEDAS 3.00 was released in April 2018; SPEDAS 3.1 expected in July 2018.
  - SPEDAS 3.1 will include support for the TS07D field model implemented in the latest update to the GEOPACK library, a plugin for ICON, and a GUI interface for performing Minimum Variance Analysis.
  - Our QA procedures, release schedule, and set of deliverables need a bit more flexibility to keep up with new plugins as they are released or updated.
  - In future releases, we hope to expand the scope of some mission-specific tools (for example, particle moments, 2-D and 3-D visualization tools, spectrograms, pitch angle distributions) to more generic solutions that can be applied to multiple missions.
  - We continue to work closely with other projects, to support integrating their software tools into SPEDAS as plugins or core capabilities.
  - SPEDAS in Python: Efforts are underway to coordinate with other developers working on heliophysics packages in Python, with the goal of porting SPEDAS tools to Python

- SPEDAS Development Roadmap
  - Currently, all crash reports and help requests are routed to the THEMIS science support address, even if the crash or problem occurs in some other plugin. Future releases should allow each plugin to define its own error handlers and reporting policy.
  - We have conducted several WebEx tutorial sessions covering various capabilities of the SPEDAS software and plugins. These sessions allow us to go into far greater detail into the nuts and bolts of using SPEDAS for realistic data processing tasks.
  - We will be looking into implementing more tools to support exporting data as CDFs with standard metadata (ISTP, SPASE).

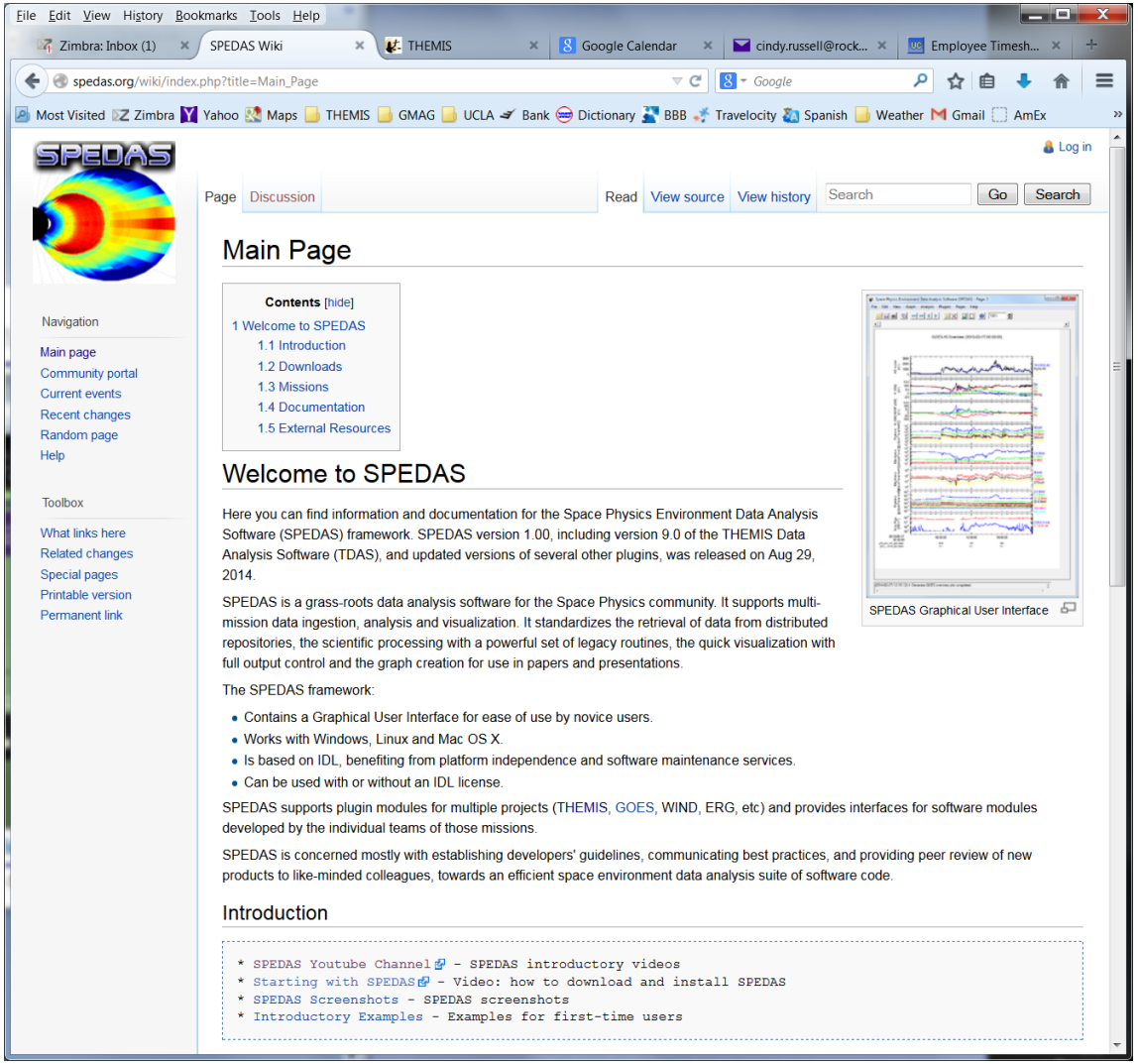
Spedas.org is now live!

- SPEDAS and plugin downloads
- Documentation wiki
- Mailing list
- Blog
- Google group (https://groups.google.com/forum/#!forum/spedas)

We welcome plugin developers to contribute content and participate in discussions on the SPEDAS site! (Registration required for wiki and blog edit privileges; please contact Jim Lewis (jwl@ssl.Berkeley.edu) to gain access).

SPEDAS Wiki

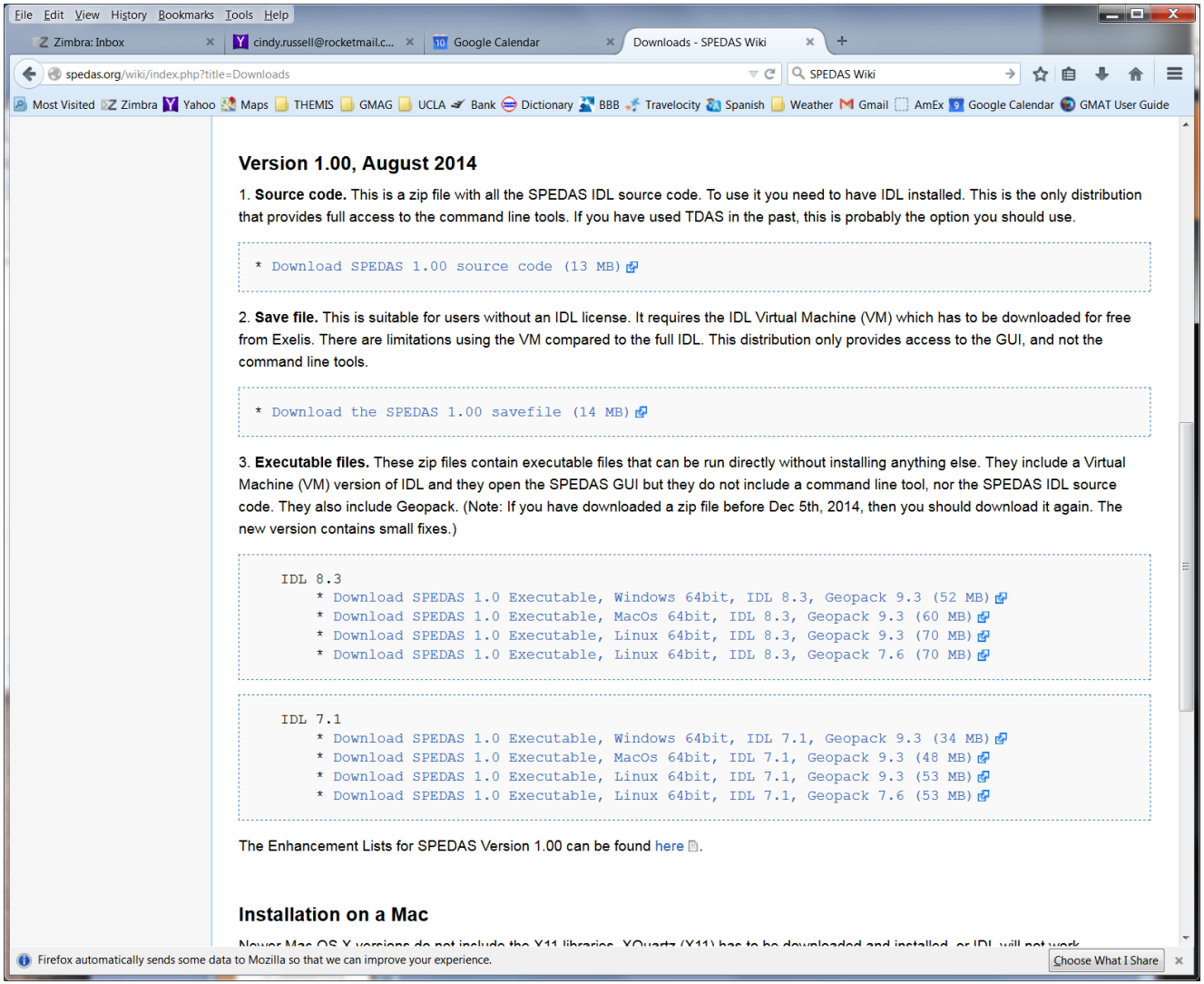
Introduction:
- You Tube Channel
- SPEDAS video
- Introductory Examples
- Screen shots



spedas.org/wiki

SPEDAS Downloads

Select:
1.2 Downloads From Main Page



spedas.org/wiki/index.php?title=Downloads

Analyzing MMS data with SPEDAS

MMS Plug-in Tutorial Tomorrow, 1:30PM!

Anasazi Ballroom

email me: egrimes@igpp.ucla.edu