IUGONET

Inter-university Upper atmosphere Global Observation NETwork

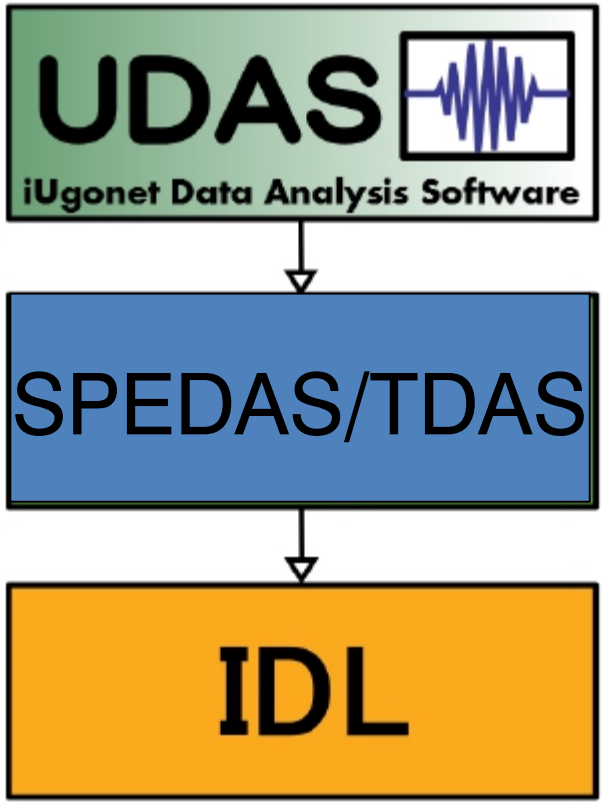
Text for Data Analysis

- *Introduction*
- *Web service IUGONET Type-A*
- *Analysis software SPEDAS/UDAS*
- *Application*

Published by IUGONET Project Team, Jan. 2019.
http://www.iugonet.org/

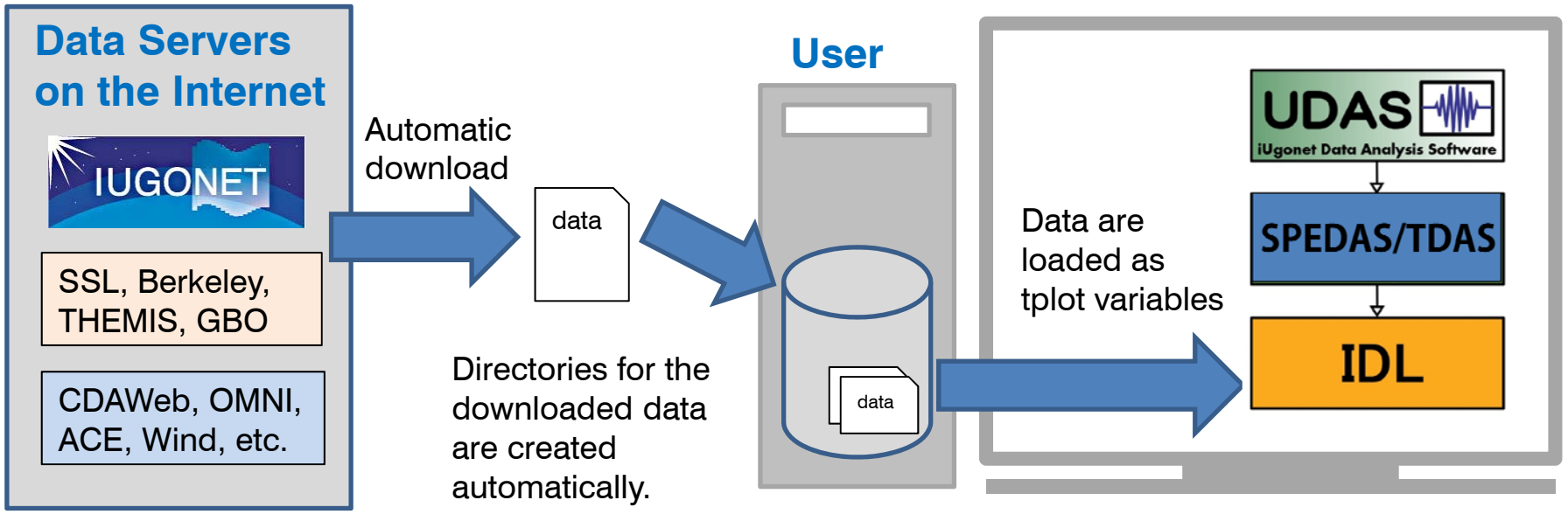
Analysis Software SPEDAS

- The IUGONET Data Analysis Software (UDAS) is the plug-in software for Space Physics Environment Data Analysis System(SPEDAS), formerly known as THEMIS Data Analysis Software suite (TDAS)
- The IUGONET data (e.g., geomagnetic data, aurora data, radar data, and so forth) and many satellite mission data (THEMIS, GOES, WIND, and ACE) can be handled.
- It is possible to use many routines to visualize and analyze time series data.
- It accesses the IUGONET data through the Internet, and then the data are automatically downloaded onto the user's computer



Relationship between UDAS, SPEDAS, and IDL

Outline of Loading/Plotting Data Using SPEDAS



Data can be easily plotted, for example, by only three basis commands with the SPEDAS-CUI tool.

1. Set a time period	timespan, 'yyyy-mm-dd'
2. Load *** data	iug_load_***
3. Plot the loaded data	tplot, +++

If using the GUI tool, only a few simple clicks of your mouse are required to make the same plot as that created by the above command with the CUI tool

A variety of SPEDAS

(1) Source code of SPEDAS

Both CUI and GUI are available.
Commercial license of IDL is required.
All functions in SPEDAS are available.
The latest version of UDAS can be applied.

(2) Executable file of SPEDAS

Only GUI version is available.
Commercial license of IDL is not required.
It includes IDL Virtual Machine, so it can be used just by downloading the archived package.

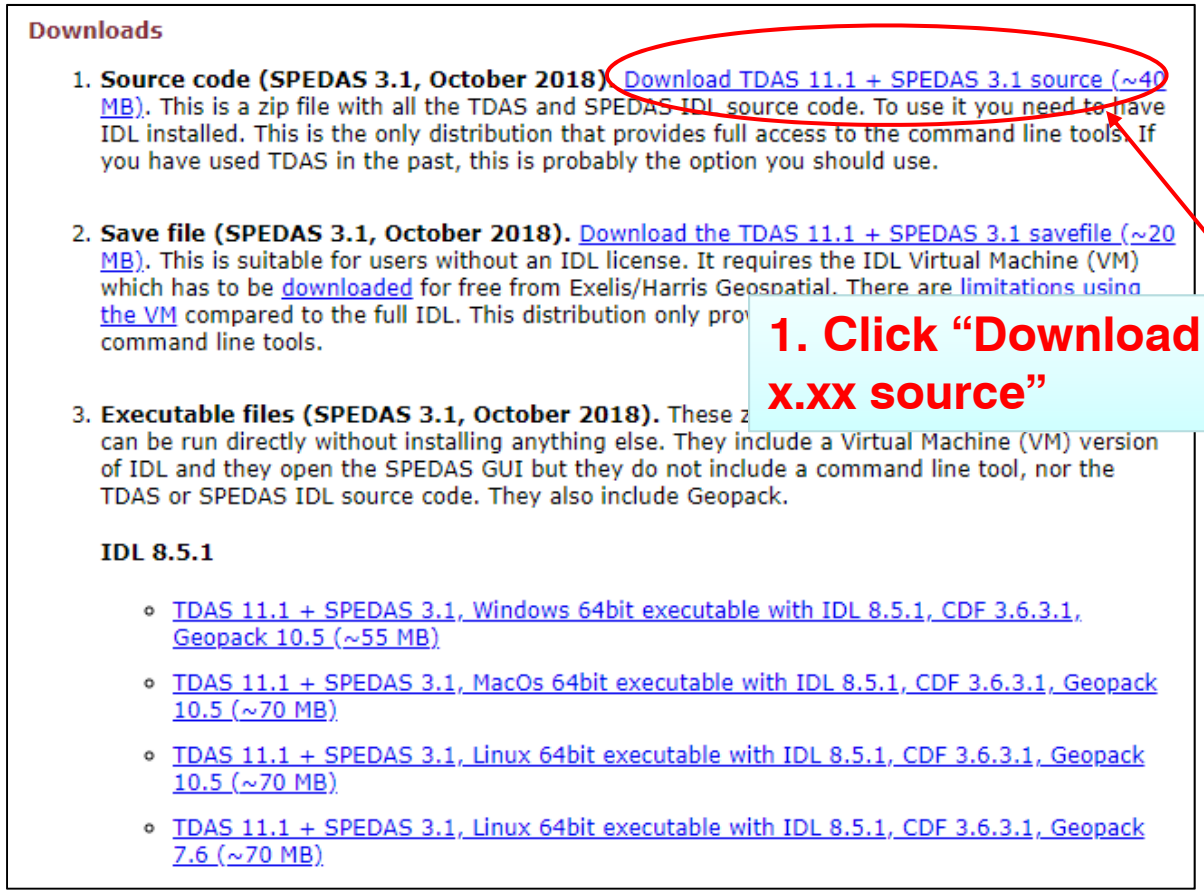
Download source code of SPEDAS

Download source code of the latest version of SPEDAS

1. Access to Software page of the THEMIS mission

http://themis.ssl.berkeley.edu/software.shtml

2. Find “Downloads”



Downloads

1. **Source code (SPEDAS 3.1, October 2018).** Download TDAS 11.1 + SPEDAS 3.1 source (~40 MB). This is a zip file with all the TDAS and SPEDAS IDL source code. To use it you need to have IDL installed. This is the only distribution that provides full access to the command line tools. If you have used TDAS in the past, this is probably the option you should use.

2. **Save file (SPEDAS 3.1, October 2018).** Download the TDAS 11.1 + SPEDAS 3.1 savefile (~20 MB). This is suitable for users without an IDL license. It requires the IDL Virtual Machine (VM) which has to be downloaded for free from Exelis/Harris Geospatial. There are limitations using the VM compared to the full IDL. This distribution only pro
command line tools.

3. **Executable files (SPEDAS 3.1, October 2018).** These z
can be run directly without installing anything else. They include a Virtual Machine (VM) version of IDL and they open the SPEDAS GUI but they do not include a command line tool, nor the TDAS or SPEDAS IDL source code. They also include Geopack.

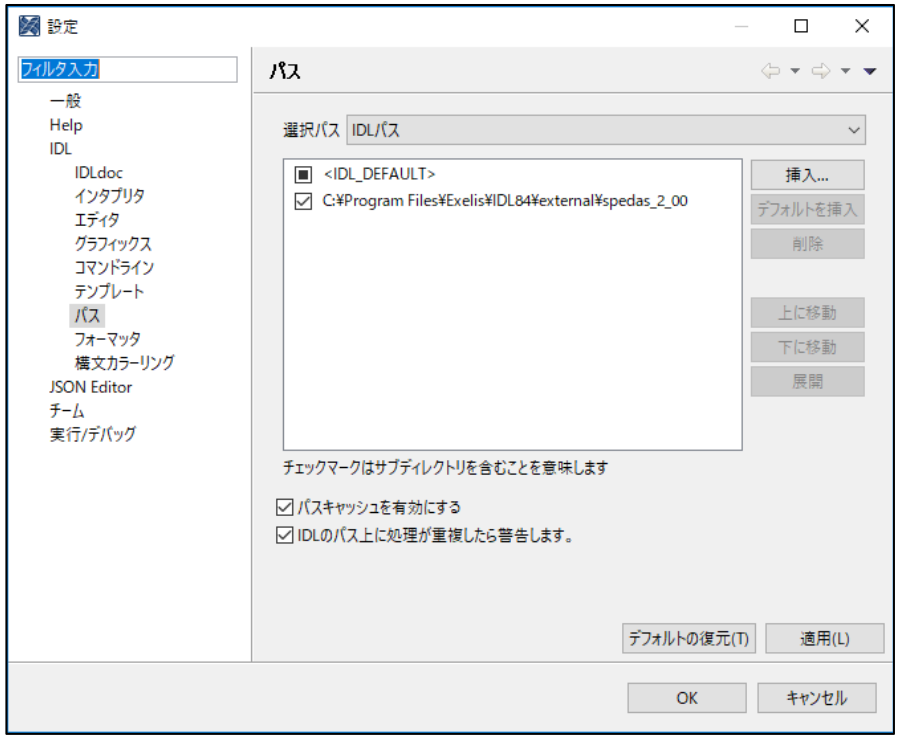
   IDL 8.5.1

   - TDAS 11.1 + SPEDAS 3.1, Windows 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~55 MB)
   - TDAS 11.1 + SPEDAS 3.1, MacOs 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~70 MB)
   - TDAS 11.1 + SPEDAS 3.1, Linux 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~70 MB)
   - TDAS 11.1 + SPEDAS 3.1, Linux 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 7.6 (~70 MB)

1. Click “Download TDAS xx.x + SPEDAS x.xx source”

Set IDL path to SPEDAS

- Both Windows and Mac
  - Copy the downloaded “spedas_x_xx.zip” to the directory you like and unzip it there.
    If you have no idea about the directory, please copy to
  - [Windows] C:¥Program Files¥Exelis¥IDL85¥external
  - [Mac] /Applications/exelis/idl85/external
- Windows
  - Run IDL8.5.
  - Window→Preferences→IDL→Path
  - Click “Insert”
  - Select “spedas_x_xx”
  - Mark the checkbox on the left and click “OK”.
- Mac
  - Run IDL8.5.
  - IDL→Preferences→IDL→Path
  - Click “Insert”
  - Select “spedas_x_xx”
  - Mark the checkbox on the left and click “OK”.



Confirm the installation of SPEDAS

Run IDL.

IDL> thm_init [enter]

THEMIS countdown: xxxxxx xxxxxx xxxx since launch

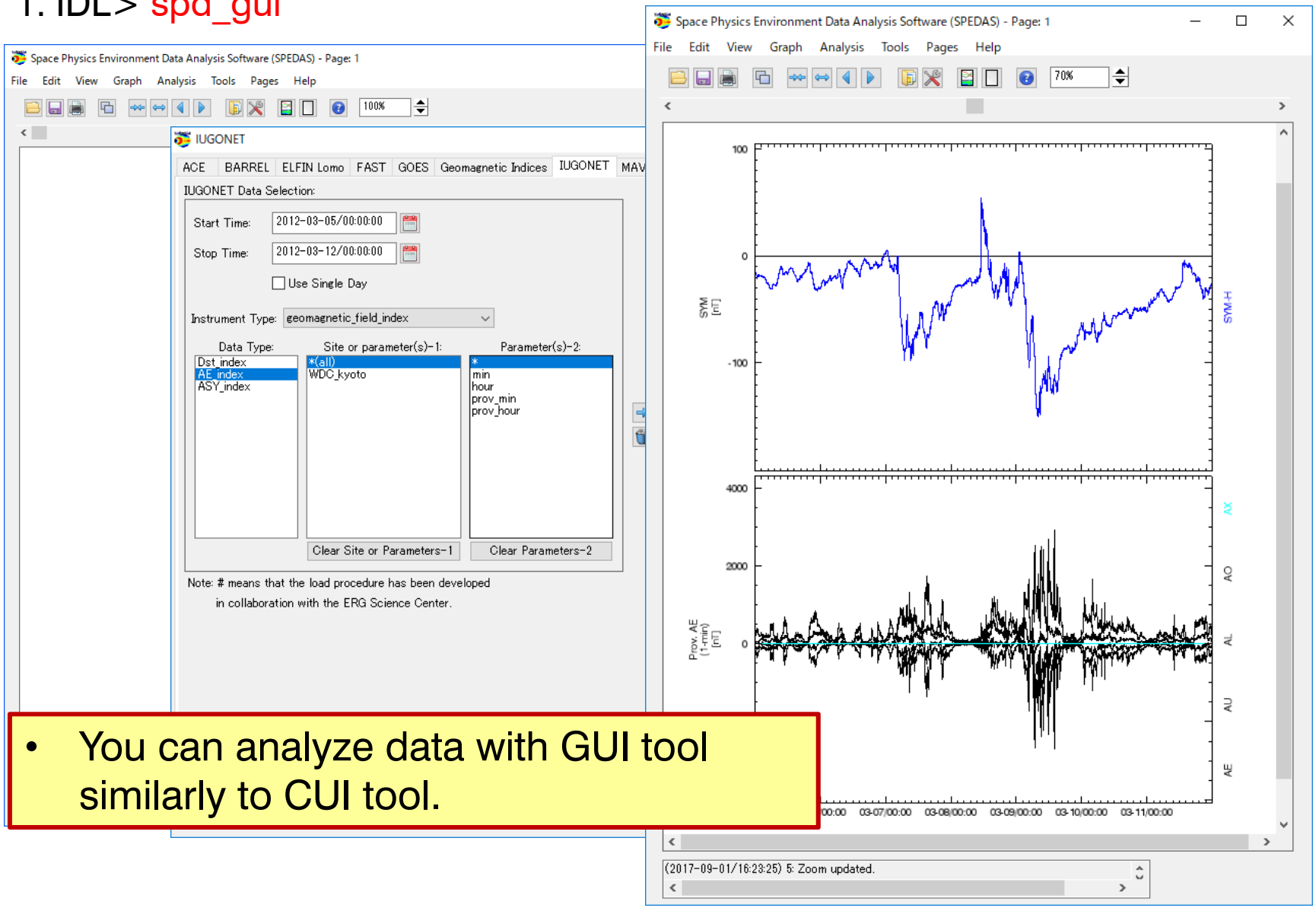
THEMIS> ← Prompt changes to “THEMIS”.

コンソール | コマンド履歴 | 問題

```
IDL> thm_init
% Compiled module: THM_INIT.
% Compiled module: FILE_RETRIEVE.
% Compiled module: DPRINT.
% Compiled module: ROOT_DATA_DIR.
% Compiled module: THM_CONFIG.
% Compiled module: THM_READ_CONFIG.
% Compiled module: THM_CONFIG_FILEDIR.
% Compiled module: THM_GRAPHICS_CONFIG.
% Compiled module: LOADCT2.
% LOADCT: Loading table FAST-Special
% LOADCT: Loading table FAST-Special
THM_CONFIG(140):
% Compiled module: TPLOT_OPTIONS.
% Compiled module: STR_ELEMENT.
% Compiled module: THM_SET_VERBOSE.
% Loaded DLM: CDF.
% Compiled module: PRINTDAT.
CDF_VERSION = STRING    = '3.6.04'
!themis = RETRIEVE_STRUCT --(23 Tags/136 Bytes)-->
   INIT            = 1
   LOCAL_DATA_DIR  = 'C:/Users/abeshu/Data/spedas/themis/'
   REMOTE_DATA_DIR = 'http://themis.ssl.berkeley.edu/data/themis/'
   PROGRESS        = 1
   USER_AGENT      = 'FILE_RETRIEVE: IDL8.5.1 Win32/x86_64 (abeshu)'
   FILE_MODE       = 438
   DIR_MODE        = 511
   PRESERVE_MTIME  = 1
   PROGOBJ         = <NullObject>
   MIN_AGE_LIMIT   = 30
   NO_SERVER       = 0
   NO_DOWNLOAD     = 0
   NO_UPDATE       = 0
   NO_CLOBBER      = 0
   ARCHIVE_EXT     = ''
   ARCHIVE_DIR     = ''
   IGNORE_FILESIZE = 0
   IGNORE_FILEDATE = 0
   DOWNLOADONLY    = 0
   USE_WGET        = 0
   NOWAIT          = 0
   VERBOSE         = 2
   FORCE_DOWNLOAD  = 0
% Compiled module: TIME_DOUBLE.
% Compiled module: TIME_STRUCT.
% Compiled module: TIME_PARSE.
% Compiled module: DAY_TO_YEAR_DOY.
% Compiled module: DOY_TO_MONTH_DATE.
% Compiled module: UNDEFINED.
% Compiled module: PTRACE.
THM_INIT(143):
THEMIS countdown:3523 Days, 18 Hours, 03 Minutes, 22 Seconds since launch
THEMIS>
```

GUI version of SPEDAS

1. IDL> spd_gui

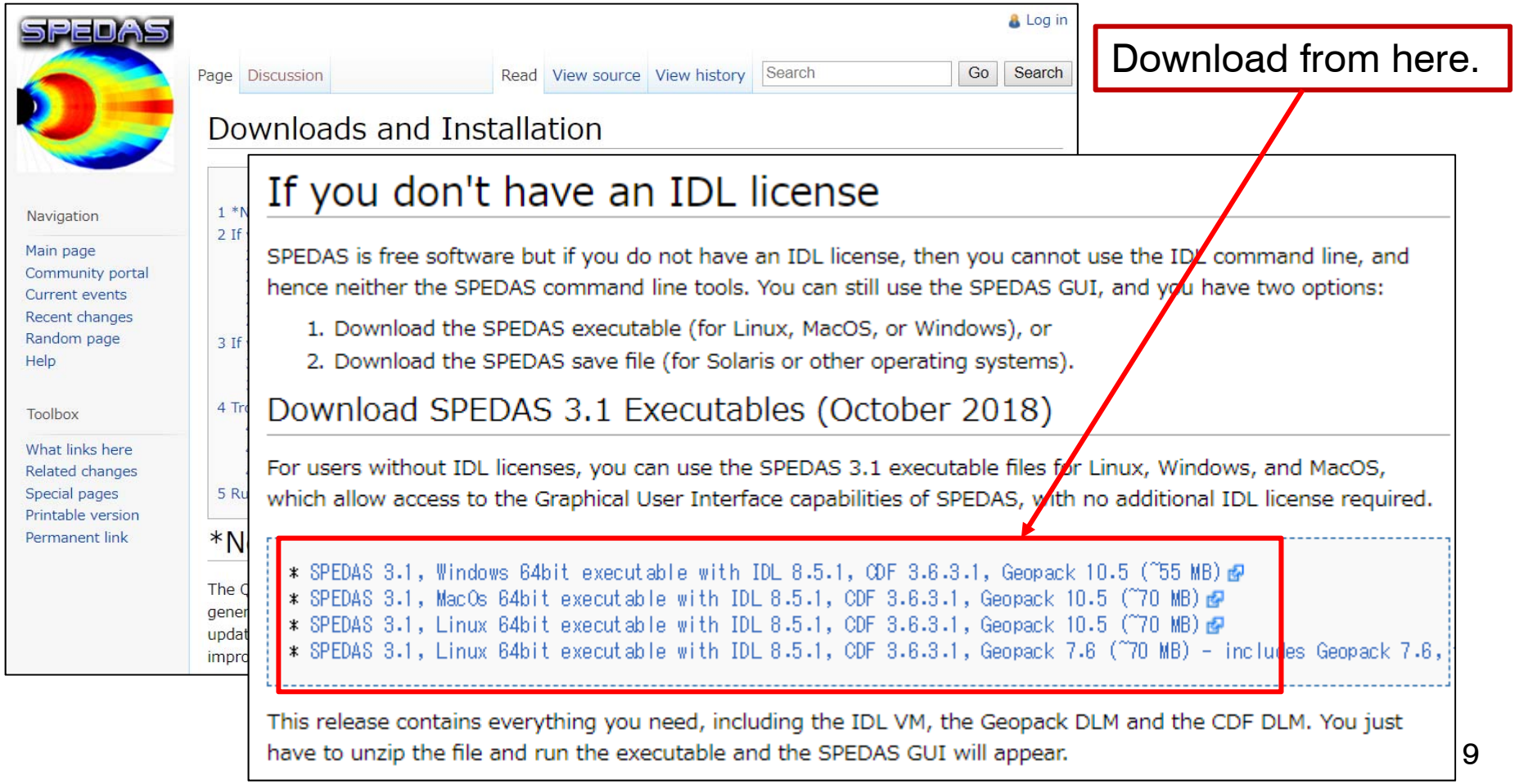


- You can analyze data with GUI tool similarly to CUI tool.

How to install SPEDAS-GUI (VM version)

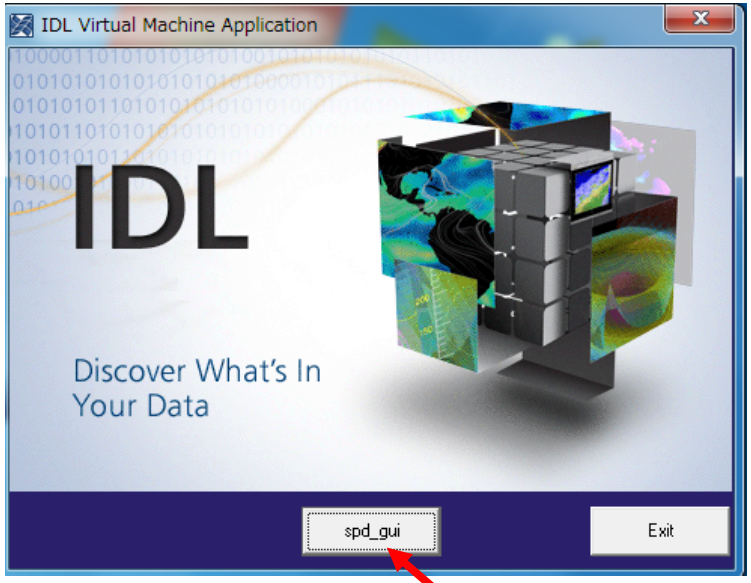
Even if you have not yet installed IDL on your PC, you can install GUI tool (VM version) soon and participate in the lecture.

http://spedas.org/wiki/index.php?title=Downloads_and_Installation
(Search by “spedas install”.)

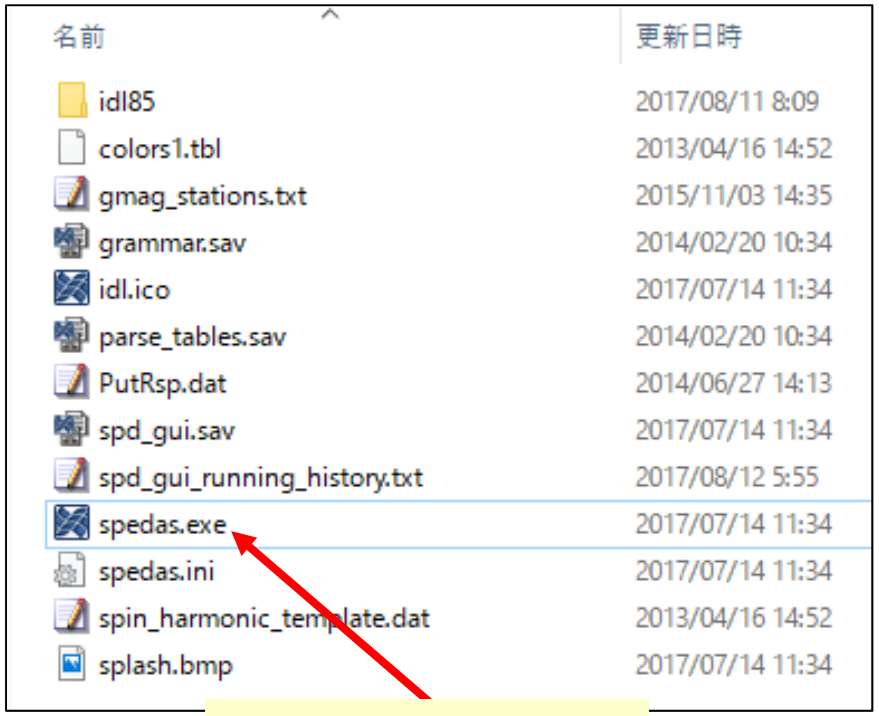


How to run SPEDAS-GUI (VM version)

[1] Double click **'spedas'** in the unzipped directory: 'spedas_v_x/spd_gui/'



Ckick 'spd_gui' button.



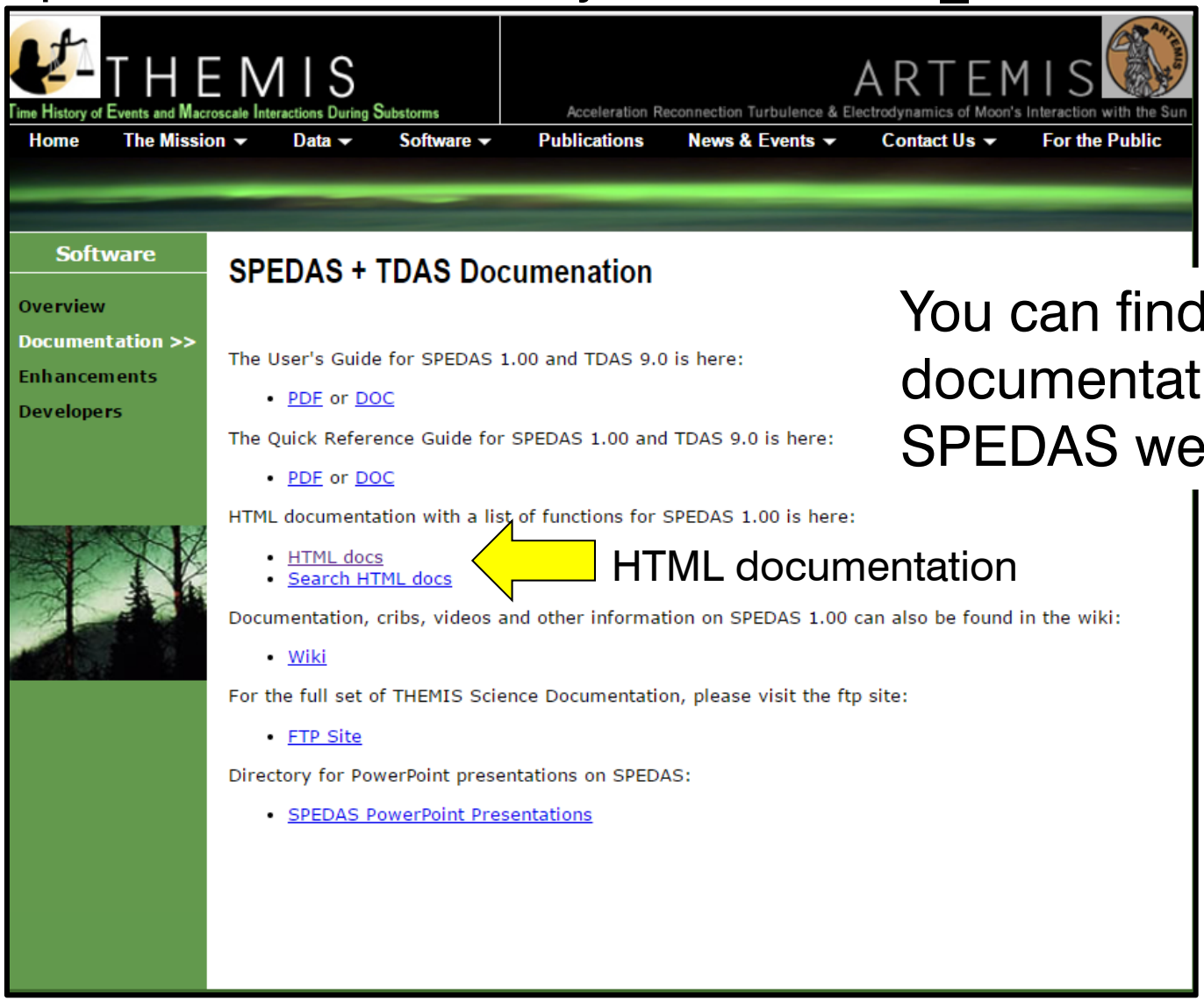
Double click this.

[2] Then, IDL Virtual Machine window opens. Click **'spd_gui'** button.

IDL license is not required.

Help 1 : SPEDAS HTML documentation (1)

http://themis.ssl.berkeley.edu/software_docs.shtml



You can find the HTML documentations at SPEDAS website

Help 1 : SPEDAS HTML documentation (2)

http://themis.ssl.berkeley.edu/socware/spedas_x_xx/idl/_spd_doc.html

SW Help for spedas_3_1

This page was created by the IDL library routine mk_html_help2.

Last modified: Tue Oct 23 09:41:30 2018.

3 , A , B , C , D , E , F , G , H , I , J , K , L , M , N , O

Directories Searched:

- external/IDL_GEOPACK
- external/IDL_GEOPACK/examples
- external/IDL_GEOPACK/t01
- external/IDL_GEOPACK/t04s
- external/IDL_GEOPACK/t89
- external/IDL_GEOPACK/t96
- external/IDL_GEOPACK/trace
- external/IDL_GEOPACK/ts07
- external/IDL_ICY
- external/developers/outliers_and_convolution
- external/developers/solarwind
- external/misc
- external/spdfcdas

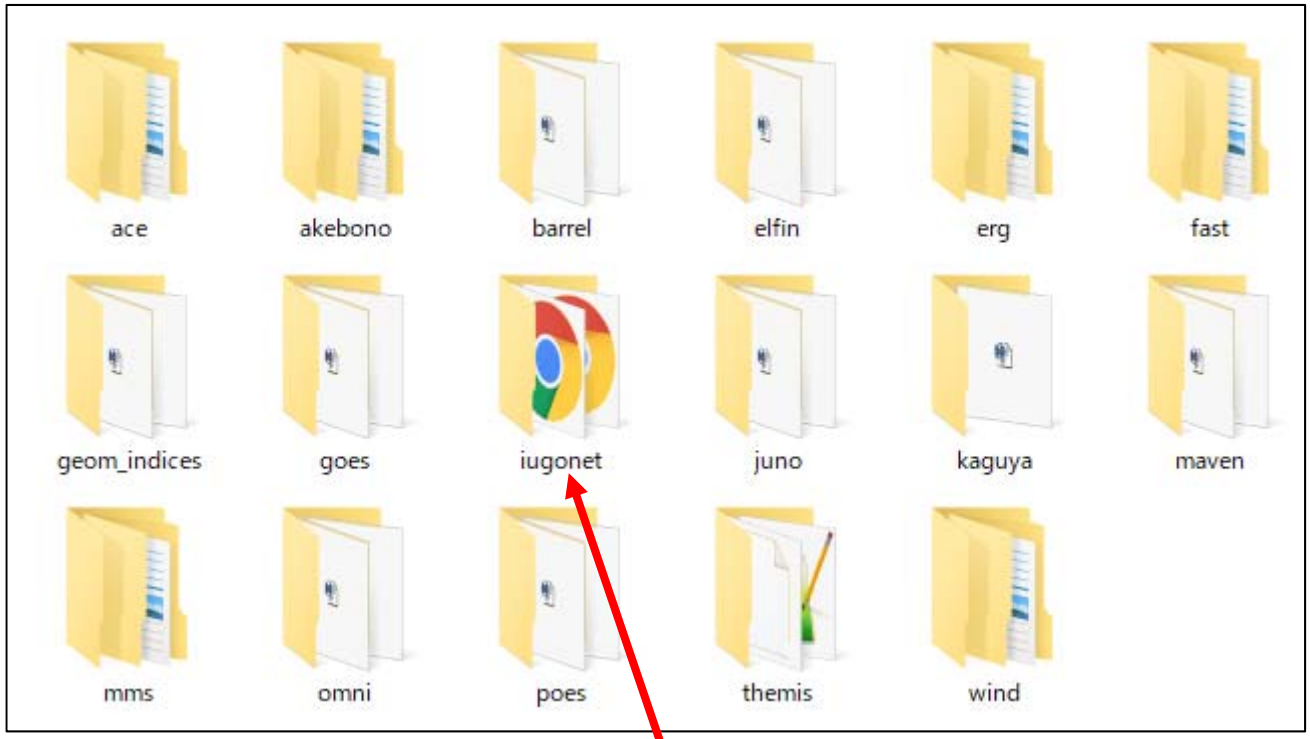
```
;
;Procedure: ACE_MFI_LOAD
;
;Purpose:  Loads ACE fluxgate magnetometer data
;
;keywords:
;    TRANGE= (Optional) Time range of interest  (2 element array)
;    /VERBOSE : set to output some useful info
;Example:
;    ace_mfi_load
;Notes:
;  This routine is still in development.
; Author: Davin Larson
;
; $LastChangedBy: davin-win $
; $LastChangedDate: $
; $LastChangedRevision:  $
; $URL $
;-
pro ace_mfi_load,type,files=files,trange=trange,verbose=verbose,
      varformat=varformat,datatype=datatype, $
      addmaster=addmaster,tplotnames=tn,source_options=source

if not keyword_set(datatype) then datatype = 'k0'

istp_init
if not keyword_set(source) then source = !istp
```

Help 2: Example crib sheet (1)

In the directory “spedas_x_xx/idl/projects”:



There are many example scripts named “crib sheet” in these directories.

Help 2: Example crib sheet (2)

iug_crib_ask_nipr.pro

```
; Initialize
thm_init

; Set the date and duration (in days)
timespan, '2012-01-22'

; Load NIPR data
iug_load_ask_nipr,site='tro', wavelength='0000'

; View the loaded data names
tplot_names

; Plot the loaded data
tplot, ['nipr_ask_tro_0000_ns', 'nipr_ask_ew_tro_0000_ew']

; Stop
print,'Enter ".c" to continue.'
stop

; Set new timespan
timespan,'2012-01-22/18:00:00',6,/hours
```

You can copy and paste these commands to IDL command line.

Or,

Run these scripts as follows:
IDL> .r iug_crib_ask_nipr

Help 3: Use IUGONET Type-A

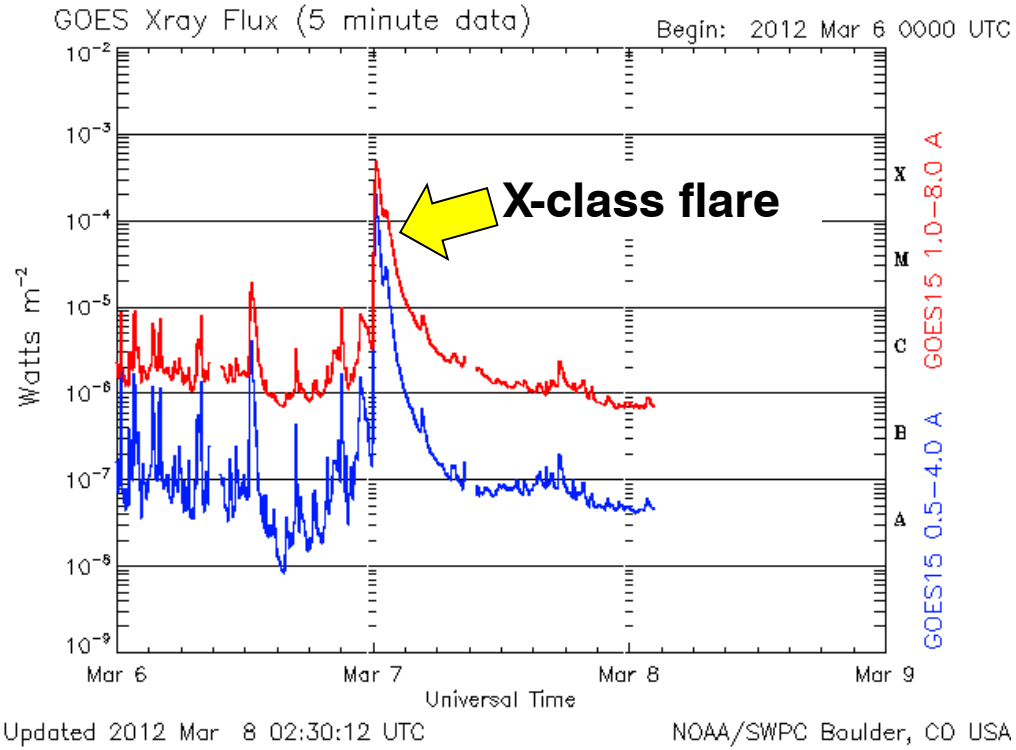
http://search.iugonet.org

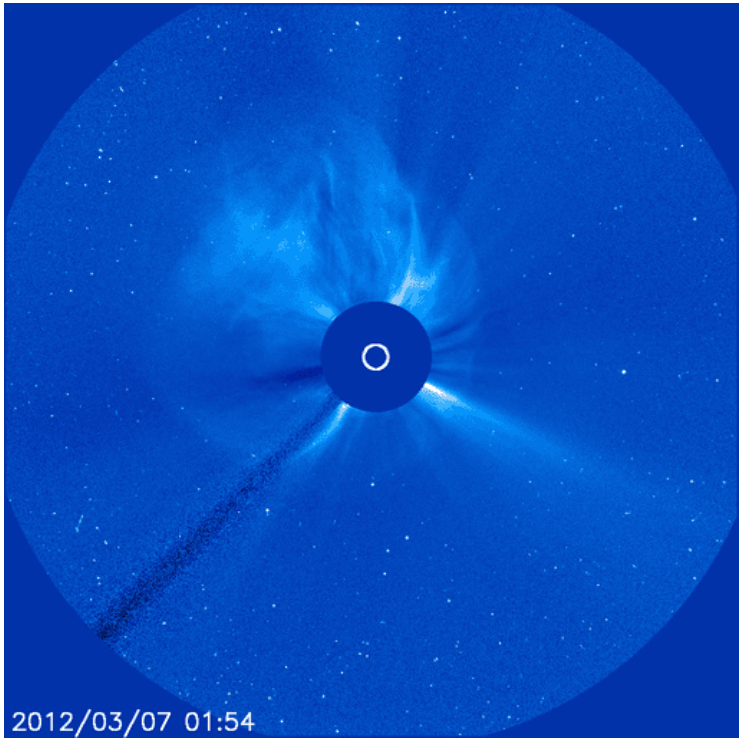
We explain how to use the IUGONET Type-A later.

What event do we analyze today?

We analyze the effect of X-class flares on the solar surface on 5th and 7th March 2012 and associated coronal mass ejection (CME) on the inter-planetary space and the Earth's upper atmosphere.

GOES X-ray Flux



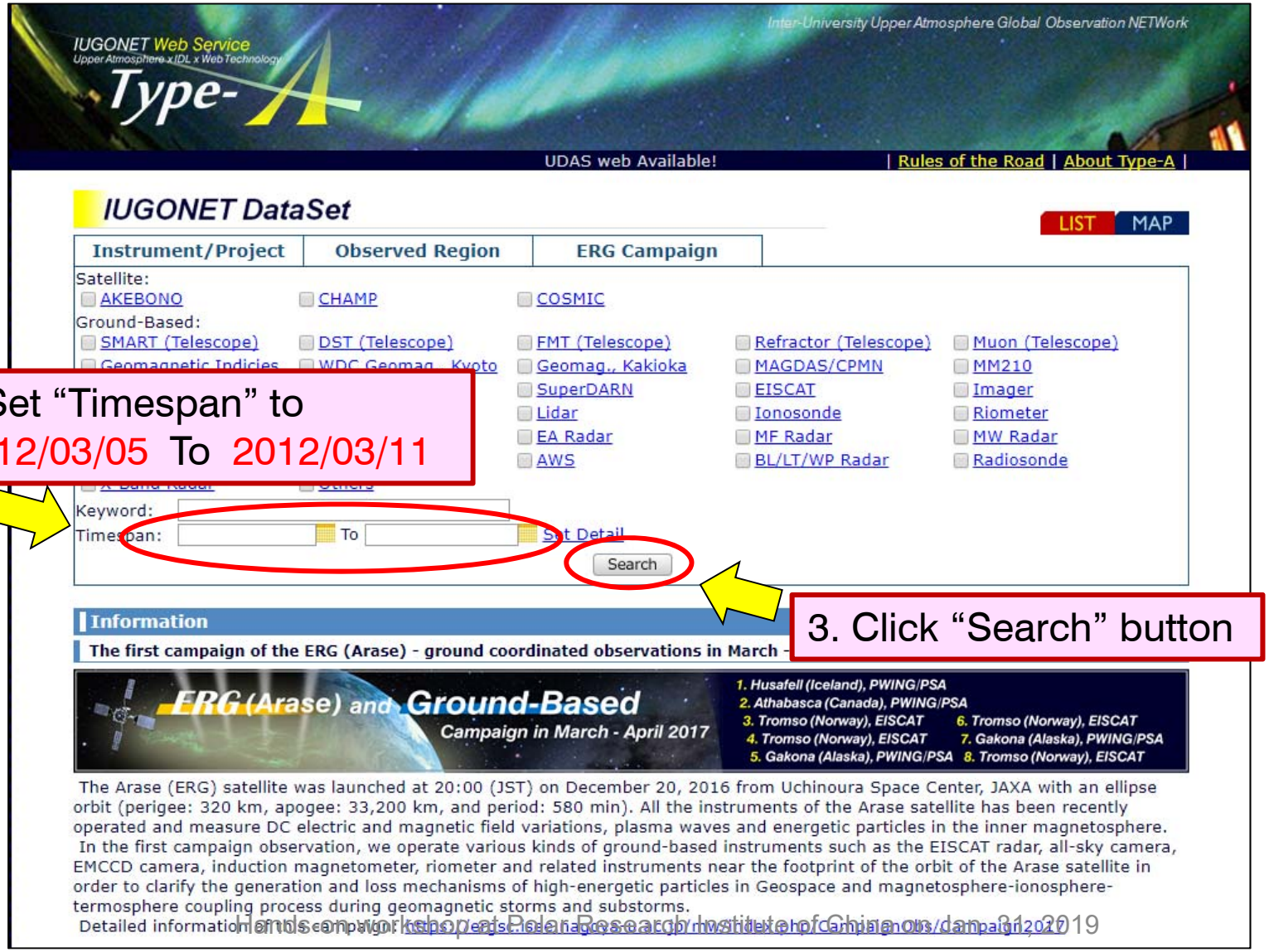


From Space Weather News http://swnews.jp/

Let’s use IUGONET web service (IUGONET Type-A)

Search data

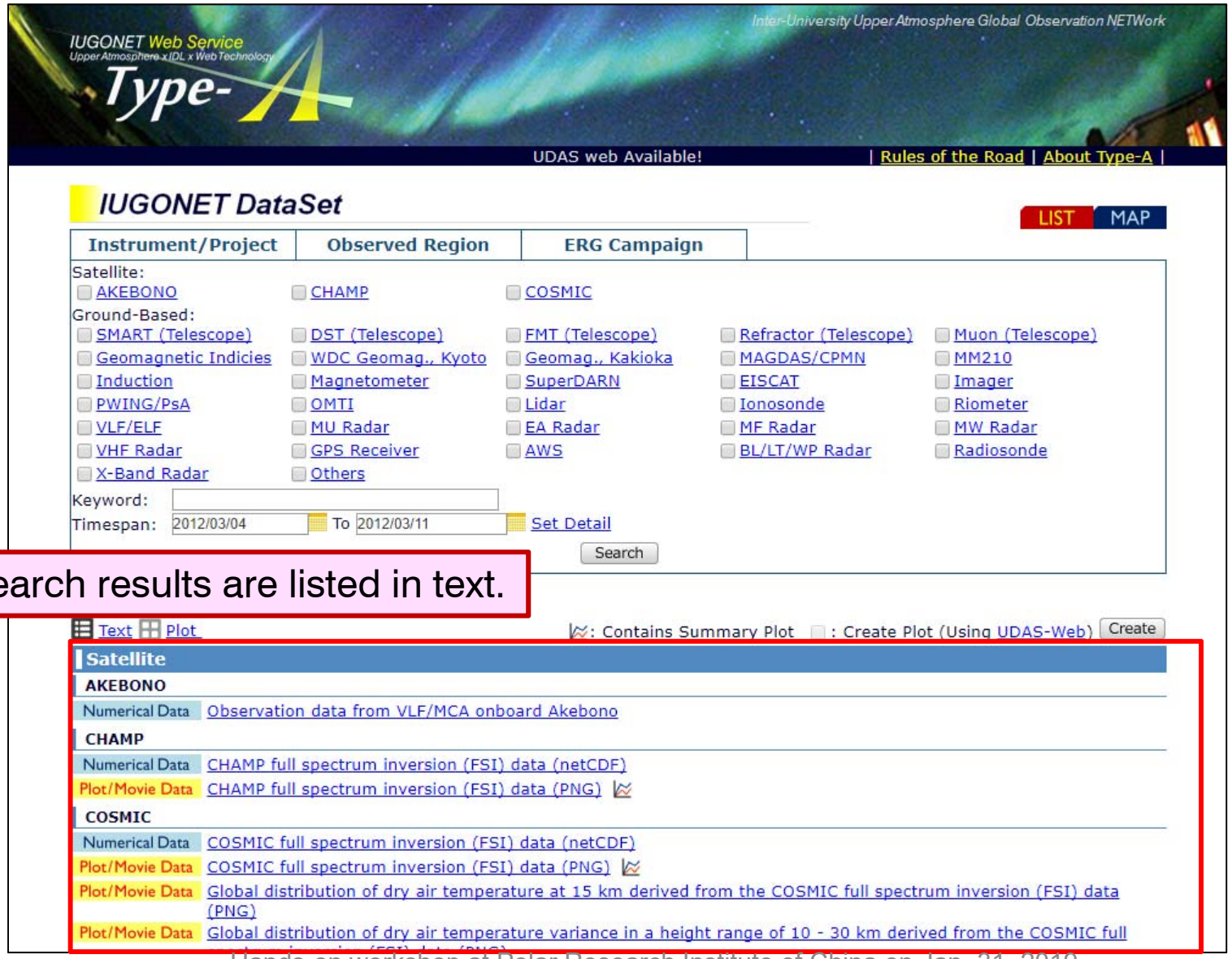
1. Access IUGONET Type-A (*http://search.iugonet.org/*)



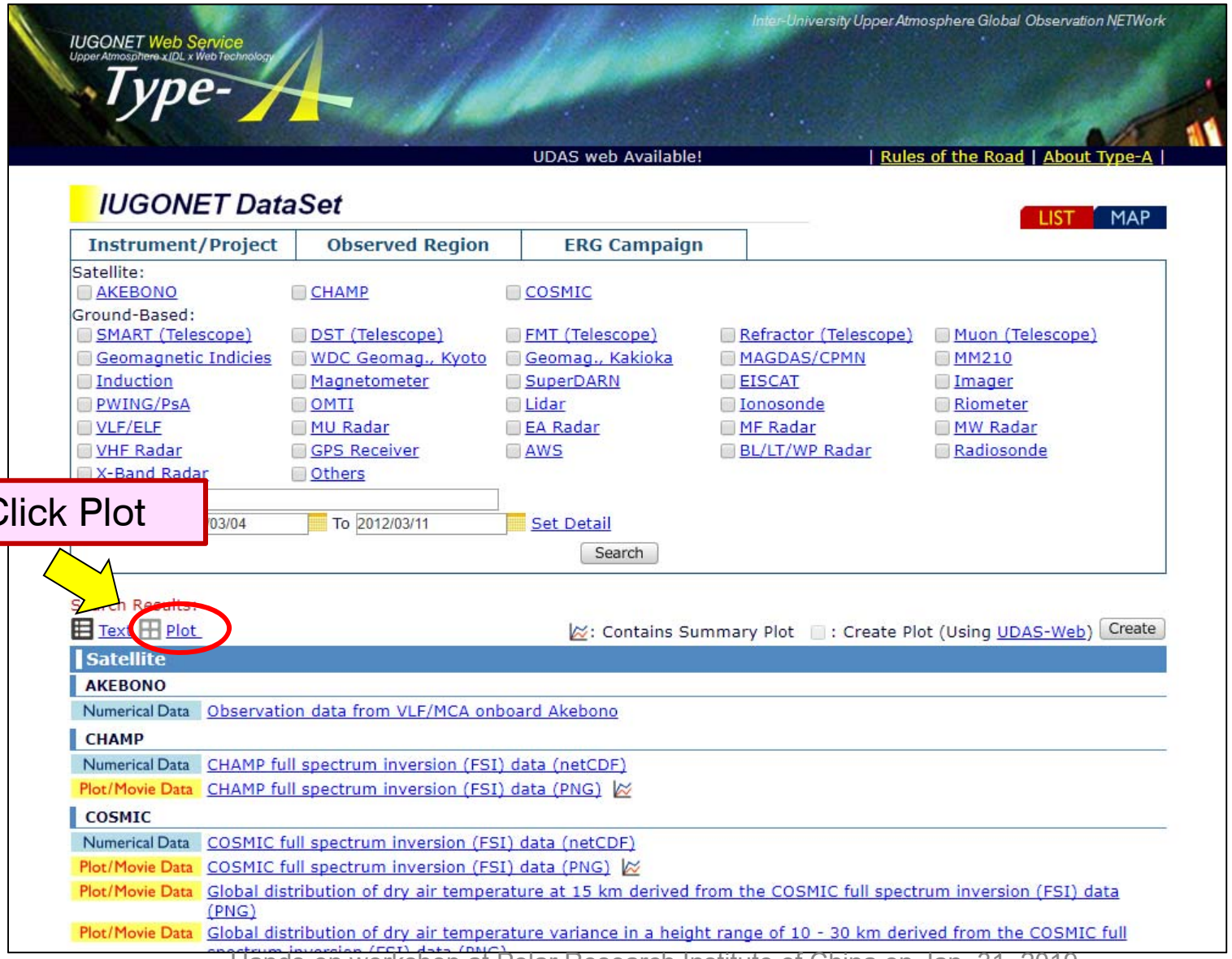
2. Set “Timespan” to
2012/03/05 To 2012/03/11

3. Click “Search” button

Search results (List display)



Change search result display to QL-plot



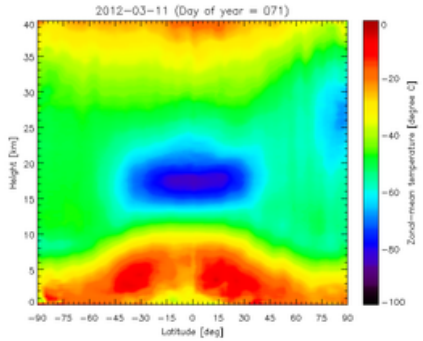
Search results (QL-plot display)

QL-plots of found data are displayed.

Text Plot <Prev Numerical: 2012/03/05 00:00:00 - 2012/03/12 00:00:00, Plot/Movie: 2012/03/11, Timespan: 1, 3, 7 Next>

Satellite

COSMIC

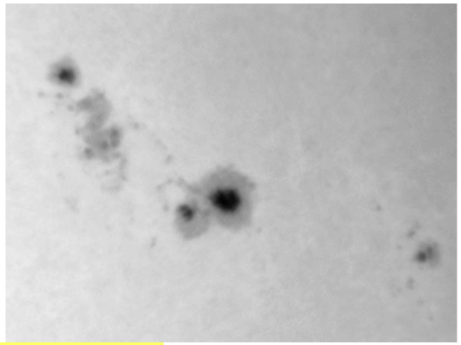


Plot/Movie Data COSMIC full spectrum inversion (FSI) data (PNG)

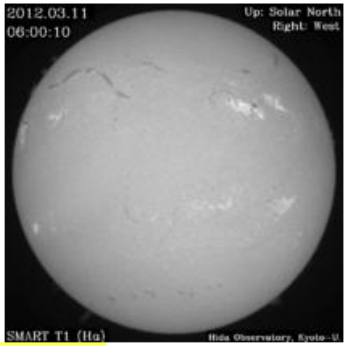
For time-series data, you can choose the time interval from 1, 3, and 7 days. The default value is 7 days.
For this example, data during the interval from 2012/03/05 to 2012/03/11 is plotted.

Ground-Based

SMART (Telescope)



Plot/Movie Data Quick-look images of SMART/T3 H-alpha and continuum partial-region solar images



Plot/Movie Data SMART/T1 H-alpha full-disk solar images in JPEG format

For image data, the QL-image on the last day of the timespan is displayed.

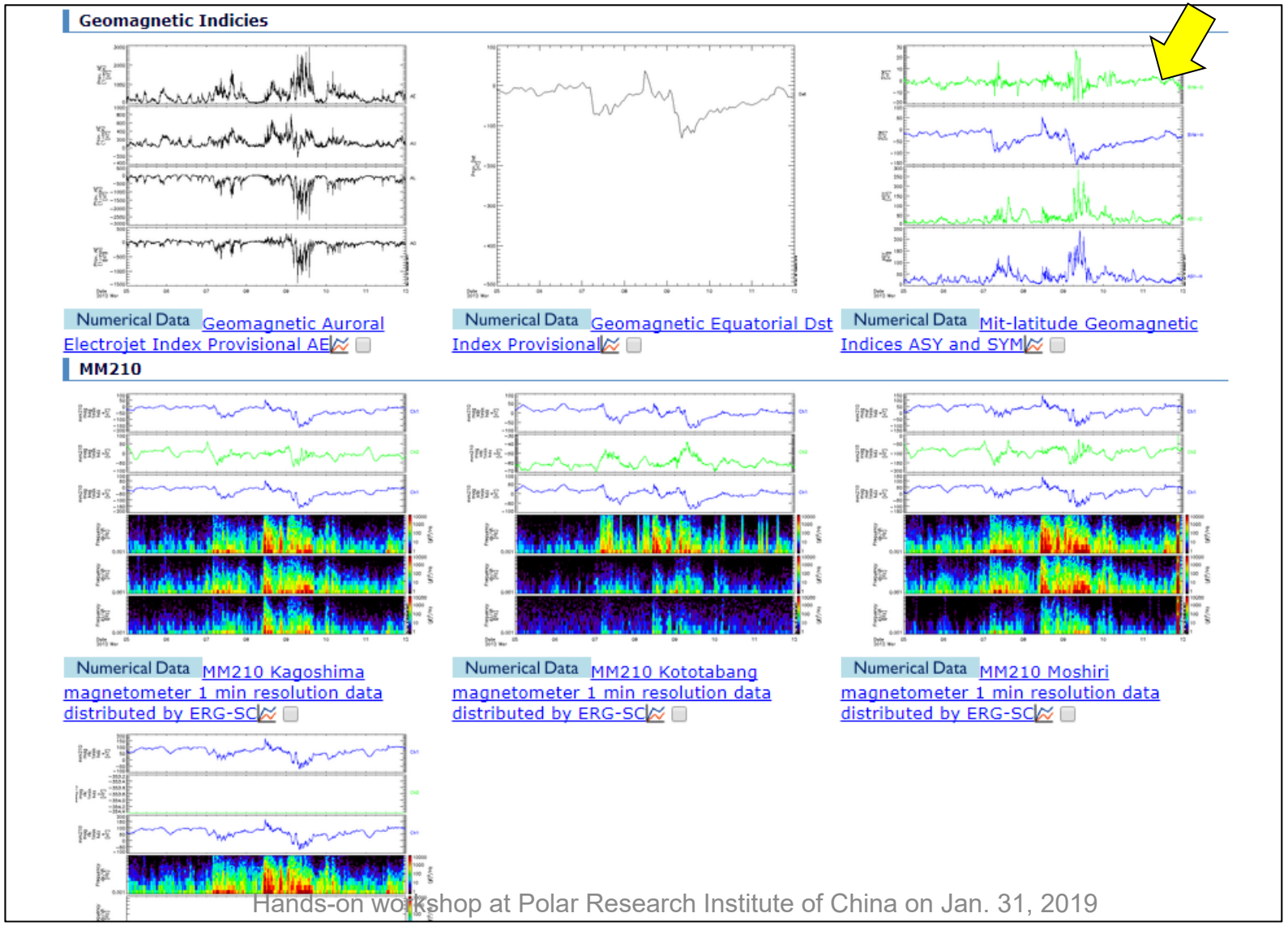
DST (Telescope)

1. Scroll

Find information of data (Metadata)

Geomagnetic Indices

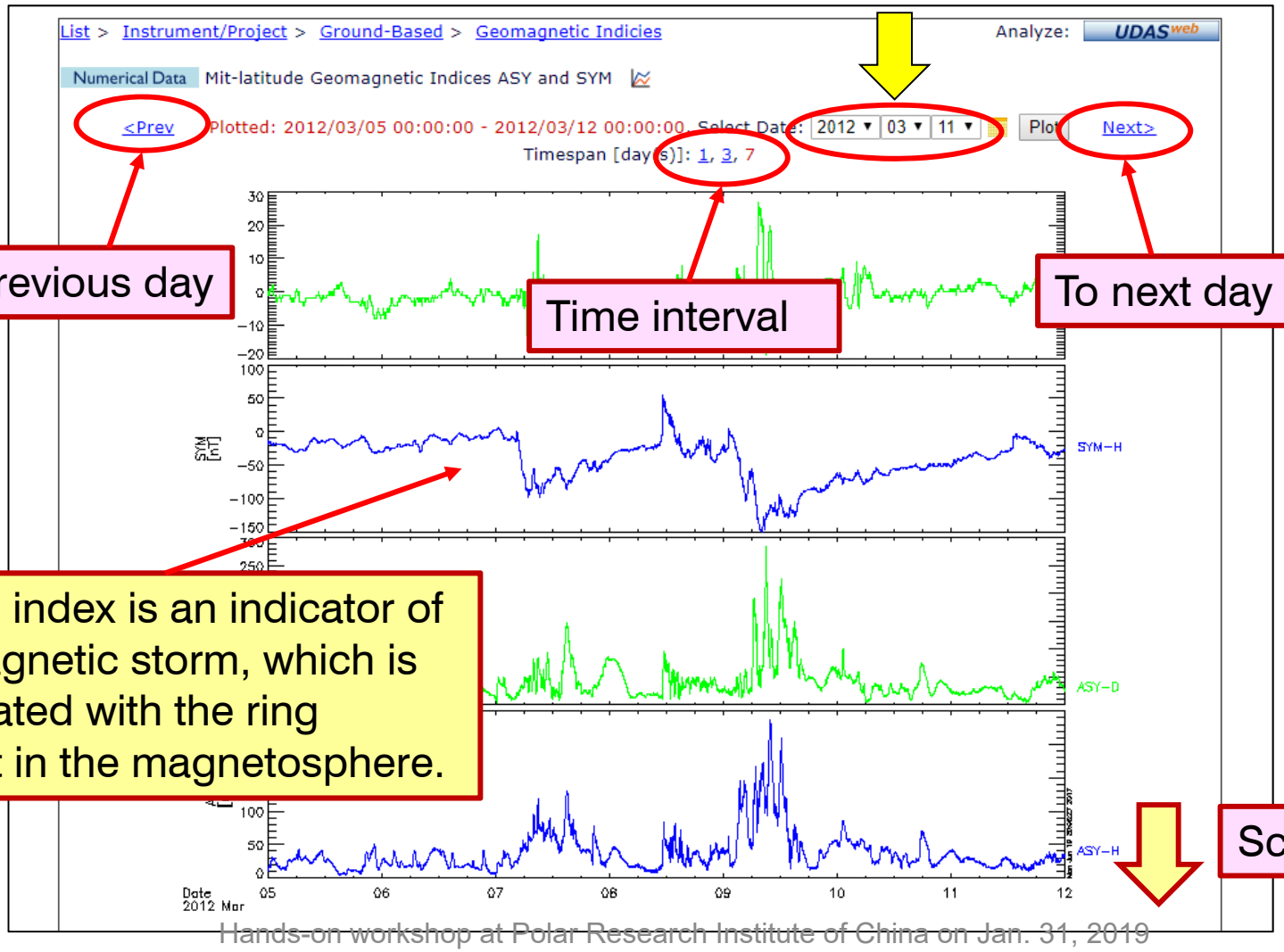
1. Click ASY and SYM indices



Change date and time interval of QL-plot

QL-plot

Set date. (This date is the last day of the timepsan)



To previous day

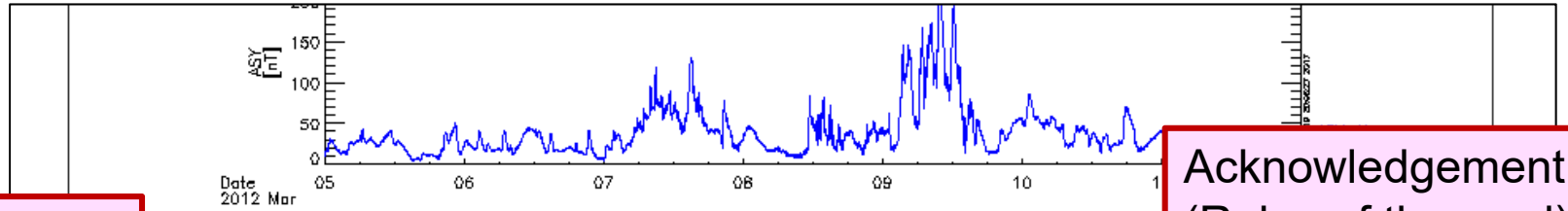
Time interval

To next day

SYM-H index is an indicator of geomagnetic storm, which is associated with the ring current in the magnetosphere.

Scroll

Detailed information of data (Metadata)



Description

Acknowledgement (Rules of the road)

Description:
The mit-latitude geomagnetic indices at 1-min time resolution, derived at World Data Center for Geomagnetism, Kyoto, Kyoto University.

Acknowledgement: If the data are used in publications and presentations, the data suppliers and the WDC for Geomagnetism, Kyoto must properly be acknowledged.

ReleaseDate: 2011-02-17T08:00:00

Contact Person

Contact (GeneralContact):
Toshihiko Iyemori, Data Analysis Center for Geomagnetism and Space Magnetism, Graduate School of Science, Kyoto University / World Data Center (WDC) for Geomagnetism, Kyoto, iyemori@kugi.kyoto-u.ac.jp

Contact (MetadataContact):
Masahito Nose', Data Analysis Center for Geomagnetism and Space Magnetism, Graduate School of Science, Kyoto University / World Data Center (WDC) for Geomagnetism, Kyoto, nose@kugi.kyoto-u.ac.jp

Access Information

AccessInformation:
Acknowledgement: If the data are used in publications and presentations, the data suppliers and the WDC for Geomagnetism, Kyoto must properly be acknowledged.
URL: http://wdc.kugi.kyoto-u.ac.jp/wdc/Sec3.html
Availability: Online
Access Rights: Open
Format: Text

Processing Level: Calibrated
Measurement Type: ActivityIndex

Time Span:
StartDate: 1981-01-01T00:00:00
StopDate: -P1D

Observed Region: Earth.Surface

Scroll

Find how to analyze data using SPEDAS

"How to Plot" shows
SPEDAS commands to plot data and how to plot data by using GUI tool.

How to Plot (SPEDAS-CUI #Basic):

```
IDL>      thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_wdc, site='sym asy'
THEMIS> tplot, ['wdc_mag_sym', 'wdc_mag_asy']
```

CUI #Basic:
Minimally needed commands to plot data

How to Plot (SPEDAS-CUI #Advanced [*Quick-Look was created with this command]):

```
IDL>      thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_wdc, site='sym asy'
THEMIS> split_vec, 'wdc_mag_sym'
THEMIS> split_vec, 'wdc_mag_asy'
THEMIS> tplot, ['wdc_mag_sym_0', 'wdc_mag_sym_1', 'wdc_mag_asy_0', 'wdc_mag_asy_1']
```

CUI #Advanced:
Commands used to make QL-plot of data

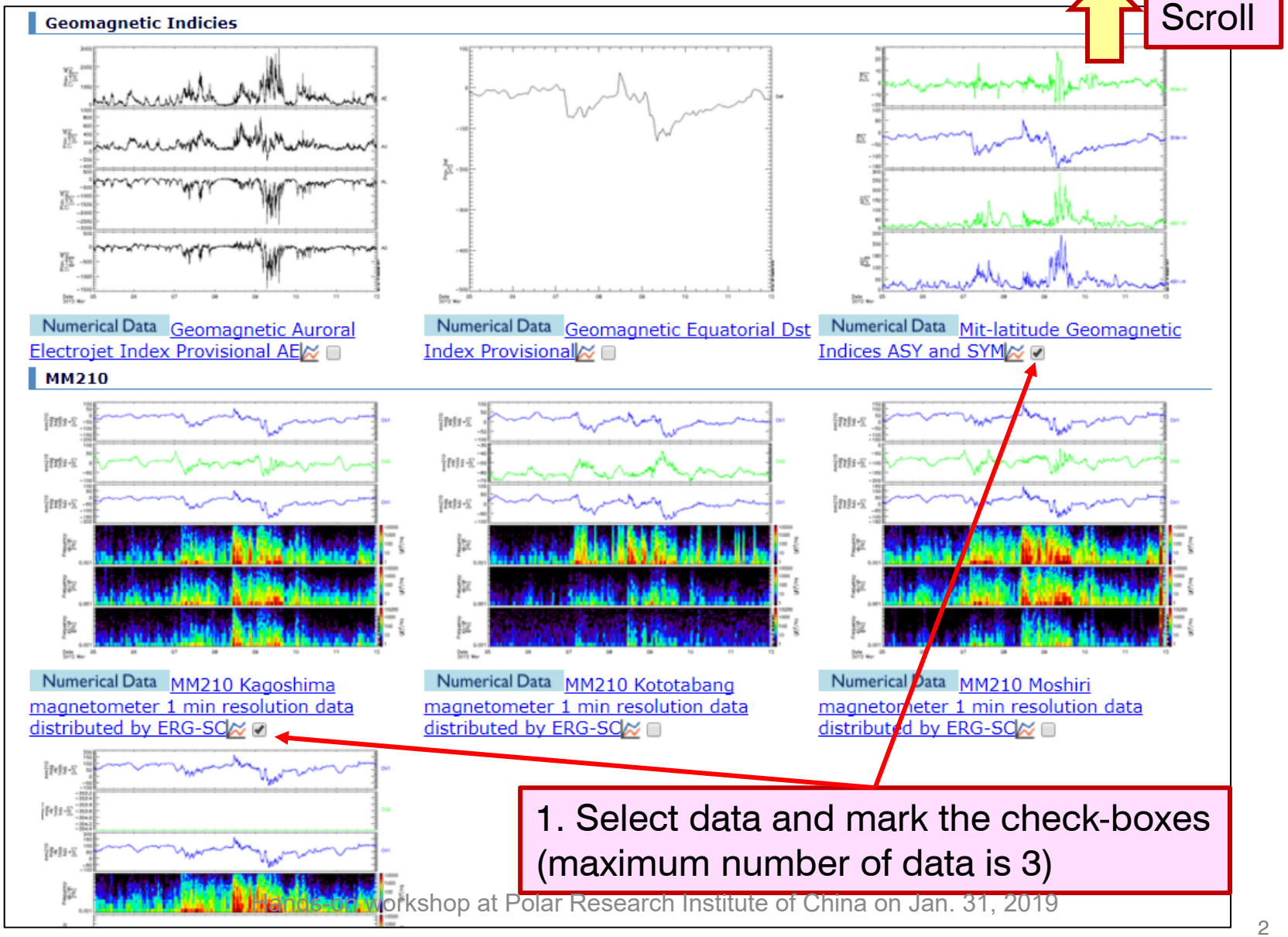
How to Plot (SPEDAS-GUI):

Step 1: Start SPEDAS GUI Program.
Step 2: Choose [FILE] -> [Load Data].
Step 3: Choose [IUGONET] Tab.
Step 4: Uncheck 'Use Single Day'.
Step 5: Set Start Time: '2012-03-05 00:00:00' and Stop Time: '2012-03-12 00:00:00'.
Step 6: Choose Instrument Type: 'geomagnetic_field_index'.
Step 7: Choose Data Type: 'ASY_index', Site or parameter(s)-1: 'WDC_kyoto' and parameter(s)-2: 'asy', 'sym'.
Step 8: Push [->] button. (Please wait a few minutes).
Step 9: Push [Done] button.
Step 10: Choose [Graph] -> [Plot Layout Options].
Step 11: Choose 'wdc_mag_asy', 'wdc_mag_sym' and push [Line->] button.
Step 12: Push [OK] button.

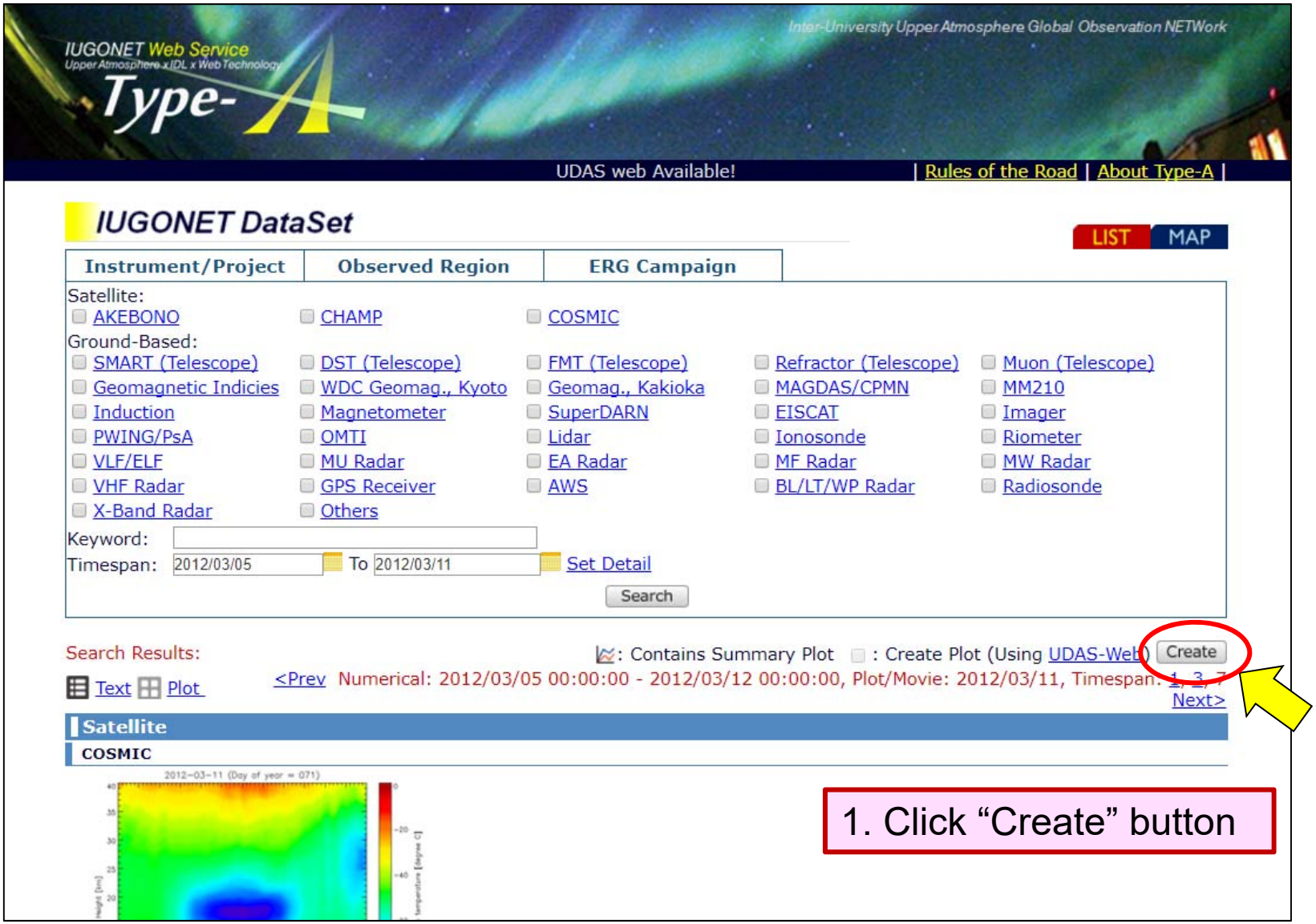
GUI:
How to plot data by GUI tool.

Return to Search Result Page.

Plot multiple data using UDAS web (1)

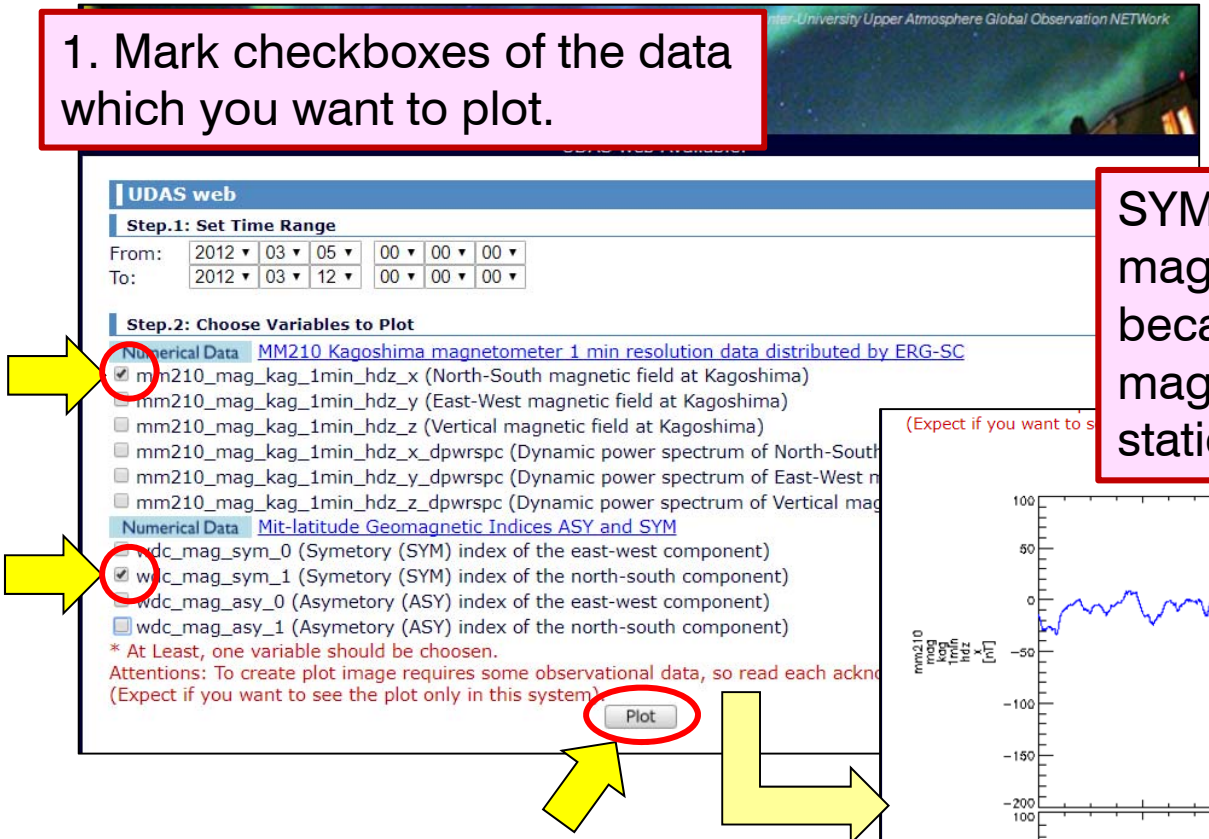


Plot multiple data using UDAS web (2)



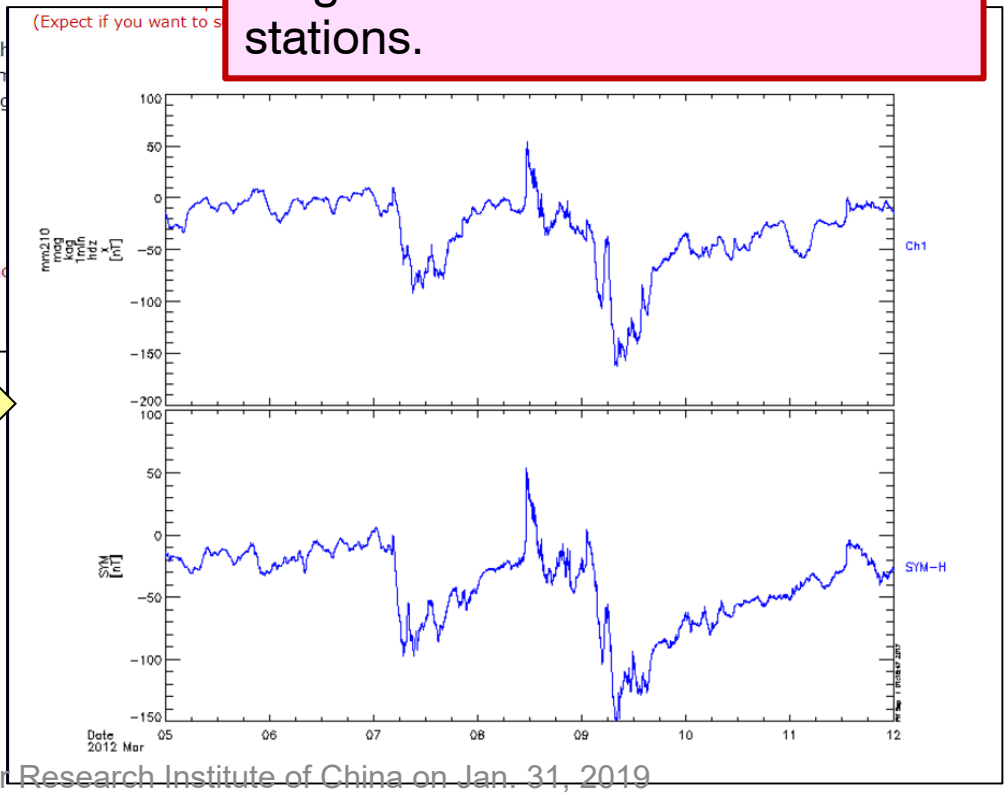
Plot multiple data using UDAS web (3)

1. Mark checkboxes of the data which you want to plot.



2. Click “Plot” button.

SYM-H index is similar to the magnetic data at Kagosima, because SYM-H is created from magnetic field at low-latitude stations.



Analyze data using SPEDAS

Use “How to Plot” in IUGONET Type-A

```
How to Plot (SPEDAS-CUI #Basic):
IDL>      thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_wdc, site='sym asy'
THEMIS> tplot, ['wdc_mag_sym', 'wdc_mag_asy']

How to Plot (SPEDAS-CUI #Advanced [*Quick-Look was created with this command]):
IDL>      thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_wdc, site='sym asy'
THEMIS> split_vec, 'wdc_mag_sym'
THEMIS> split_vec, 'wdc_mag_asy'
THEMIS> tplot, ['wdc_mag_sym_0', 'wdc_mag_sym_1', 'wdc_mag_asy_0', 'wdc_mag_asy_1']

How to Plot (SPEDAS-GUI):
Step 1:   Start SPEDAS GUI Program.
Step 2:   Choose [FILE] -> [Load Data].
Step 3:   Choose [IUGONET] Tab.
Step 4:   Uncheck 'Use Single Day'.
Step 5:   Set Start Time: '2012-03-05 00:00:00' and Stop Time: '2012-03-12 00:00:00'.
Step 6:   Choose Instrument Type: 'geomagnetic_field_index'.
Step 7:   Choose Data Type: 'ASY_index', Site or parameter(s)-1: 'WDC_kyoto' and parameter(s)-2: 'asy', 'sym'.
Step 8:   Push [->] button. (Please wait a few minutes).
Step 9:   Push [Done] button.
Step 10:  Choose [Graph] -> [Plot Layout Options].
Step 11:  Choose 'wdc_mag_asy', 'wdc_mag_sym' and push [Line->] button.
Step 12:  Push [OK] button.
```

CUI #Basic:
Minimally needed commands to plot data

CUI #Advanced:
Commands used to make QL-plot of data

GUI:
How to plot data by GUI tool.

1. Copy these SPEDAS commands by mouse.

Basic commands of SPEDAS

1. IDL> thm_init (Initialize)

2. THEMIS> timespan, 'YYYY-MM-DD/hh:mm:ss', N, /<option>
(Set timespan)
e.g., timespan, 'YYYY-MM-DD', N (N days from YYYY-MM-DD)
timespan, 'YYYY-MM-DD/hh:mm:ss', N, /hour
(N hours from YYYY-MM-DD/hh:mm:ss)

3. THEMIS> ???_load_???, site='site_name' (Load data)
"???_load_???" is the load procedure.
e.g., "iug_load_eiscat" loads EISCAT radar data.

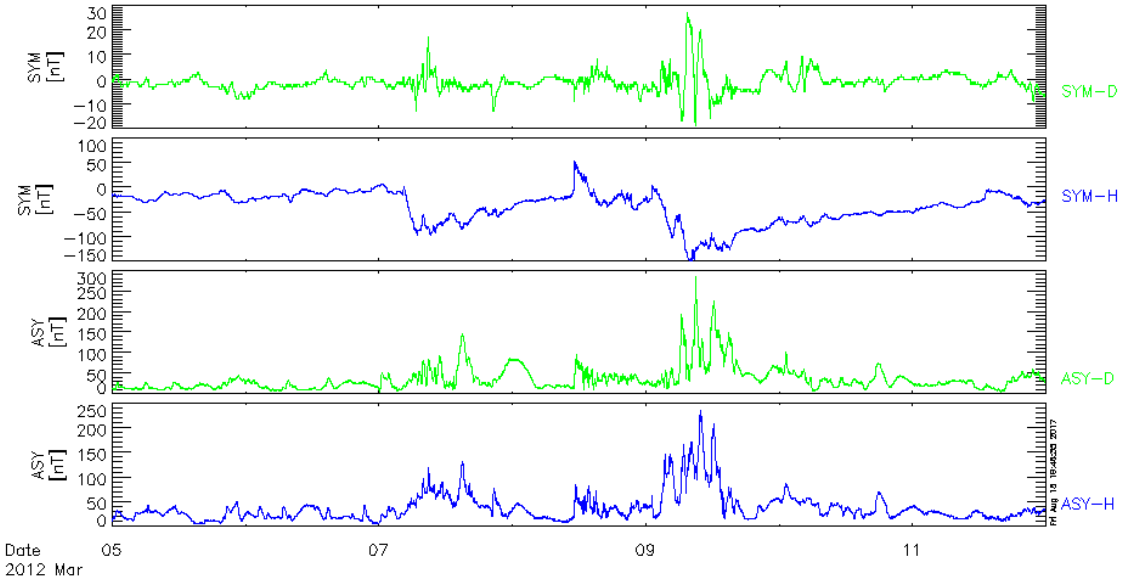
4. THEMIS> tplot, 'tplot_variable'
(Plot loaded data.)
tplot, ['tplot_variable1', 'tplot_variable2', 'tplot_variable3', ….]
tplot, [1, 2, 3, …]

Copy&Paste SPEDAS commands to IDL

0. Run IDL.
1. IDL> ← Paste the copied SPEDAS commands here and execute the commands.

```
IDL> thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_wdc, site='sym asy'      (Load SYM and ASM indices)
THEMIS> split_vec, 'wdc_mag_sym'
THEMIS> split_vec, 'wdc_mag_asy'
          (Divide SYM and ASY indices into each component (H and D).)
THEMIS> tplot, ['wdc_mag_sym_0', 'wdc_mag_sym_1', 'wdc_mag_asy_0', 'wdc_mag_asy_1']
```

You can create the same plot as QL-plot of Type-A.



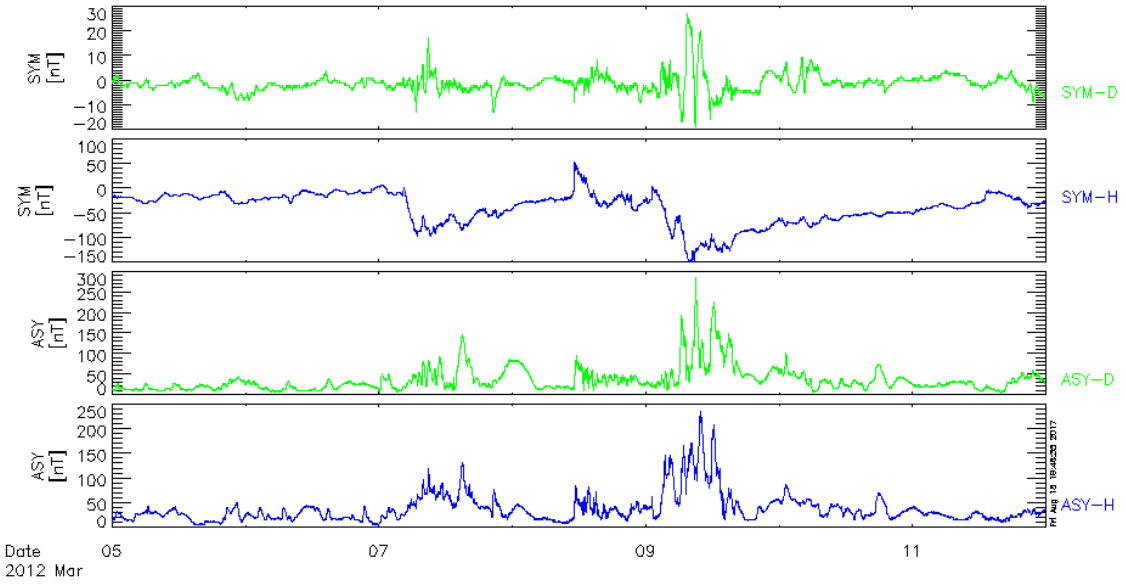
Show loaded tplot variables

Show loaded tplot variables.

tplot_names (, 'tplot_variables', /verbose)

1. THEMIS> tplot_names
   1 wdc_mag_sym
   2 wdc_mag_asy
   3 wdc_mag_sym_0
   4 wdc_mag_sym_1
   5 wdc_mag_asy_0
   6 wdc_mag_asy_1

2. THEMIS> tplot, [3, 4, 5, 6]
(Numbers for tplot variables are also available for plotting data.)



You can create the same plot as QL-plot of Type-A.

Show details of tplot variables

Show details of tplot variables.

tplot_names, 'tplot_variable', /verbose

1. THEMIS> tplot_names, 'wdc_mag_sym', /verbose

```
THEMIS> tplot_names, 'wdc_mag_sym', /verbose
% Compiled module: TPLOT_NAMES.
   1 wdc_mag_sym
     DQ = STRUCT    = TPLOT_QUANT --(7 Tags/64 Bytes)-->
        NAME         = STRING    = 'wdc_mag_sym'
        DH           = POINTER   = <PtrHeapVar10>
          *(DH) = *<PtrHeapVar10> = STRUCT    =  --(4 Tags/16 Bytes)-->
             X      = POINTER   = <PtrHeapVar13>
               *(X) = *<PtrHeapVar13> = DOUBLE[44640] = [1.3305600e+009, 1.3305601e+009, 1.3305602e+009,  ...]
             X_IND = LONG      = 44640
             Y      = POINTER   = <PtrHeapVar14>
               *(Y) = *<PtrHeapVar14> = FLOAT[44640,2] = [-1.00000, -1.00000, -1.00000, -1.00000, -1.00000,  ...]
             Y_IND = LONG      = 44640
        LH           = POINTER   = <PtrHeapVar11>
          *(LH) = *<PtrHeapVar11> = STRUCT    =  --(4 Tags/72 Bytes)-->
             COLORS     = INT[2]    = [4, 2]
             LABELS     = STRING[2] = ['SYM-D', 'SYM-H']
             YSUBTITLE = STRING    = '[nT]'
             YTITLE     = STRING    = 'SYM'
        DL           = POINTER   = <PtrHeapVar12>
          *(DL) = *<PtrHeapVar12> = STRUCT    =  --(1 Tags/16 Bytes)-->
             DATA_ATT = STRUCT    =  --(1 Tags/16 Bytes)-->
                ACKNOWLEDGMENT = STRING    = 'The rules for the data use and exchange are defined by the Guide on the
World Data Center System  (ICSU Panel on World Data Centers, 1996). Note that information on the appropriate
institution(s) is also supplied with the WDC data sets. If the data are used in publications and presentations, the data
suppliers and the WDC for Geomagnetism, Kyoto must properly be acknowledged. Commercial use and re-distribution of WDC
data are, in general, not allowed. Please ask for the information of each observatory to the WDC.The distribution of the
data has been partly supported by the IUGONET (Inter-university Upper atmosphere Global Observation NETwork) project
(http://www.iugonet.org/) funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.'
        TRANGE       = DOUBLE[2] = [1.3305600e+009, 1.3332384e+009]
        DTYPE        = INT       = 1
        CREATE_TIME = DOUBLE    = 1.5484080e+009
```

"Tplot variable" is different from normal IDL variable and includes metadata as well as numerical data.

→ allows to create good-looking plots easily with a few commands.

Add AE index to stack plot (1)

Geomagnetic Indices

Add AE index to stack plot (2)

1. THEMIS> iug_load_gmag_wdc, site='ae'
(Load AE index from Kyoto WDC.)

****
The rules for the data use and exchange are defined by the Guide on the World Data Center System (ICSU Panel on World Data Centers, 1996). Note that information on the appropriate institution(s) is also supplied with the WDC data sets. If the data are used in publications and presentations, the data suppliers and the WDC for Geomagnetism, Kyoto must properly be acknowledged. Commercial use and re-distribution of WDC data are, in general, not allowed. Please ask for the information of each observatory to the WDC.The distribution of the data has been partly supported by the IUGONET (Inter-university Upper atmosphere Global Observation NETwork) project (http://www.iugonet.org/) funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.
****

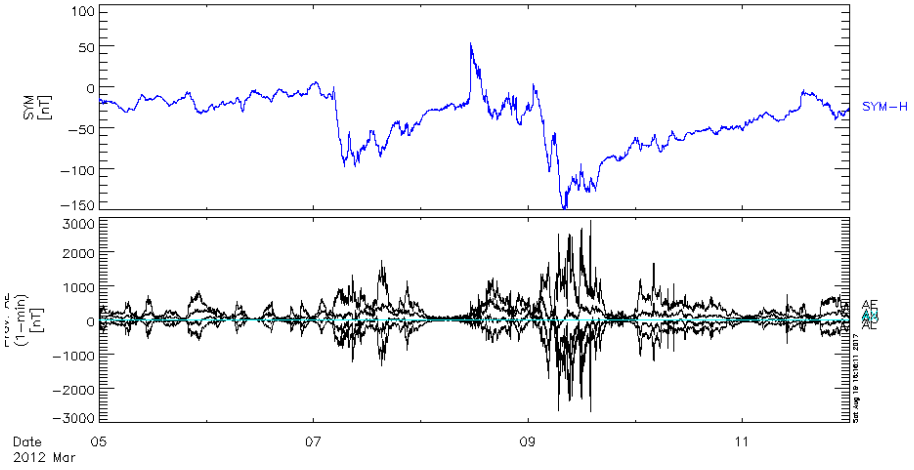
The data use policy is displayed on the CUI window. Please confirm the data use policy.

2. THEMIS> tplot_names
(Confirm the loaded data)
"wdc_mag_ae_prov_1min" is additionally displayed.

3. THEMIS> tplot, ['wdc_mag_sym_1', 'wdc_mag_ae_prov_1min']

SYM-H index:
(Indicator of geomagnetic storm)

AU, AL, AE, AO index:
(Indicator of auroral activity.)



Add AE index to stack plot (3)

Divide tplot variables into each component.

split_vec, 'tplot_variable'

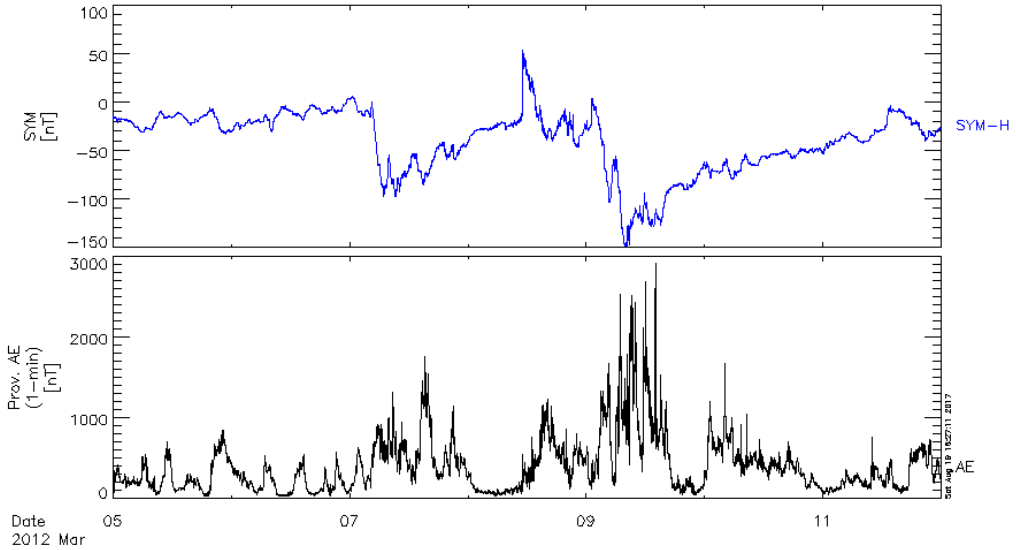
Create a vector from some time-series data.

join_vec, ['tplot_variable1', 'tplot_variable2', ….], 'tplot_variable'

1. THEMIS> split_vec, 'wdc_mag_ae_prov_1min'
2. THEMIS> tplot, ['wdc_mag_sym_1', 'wdc_mag_ae_prov_1min_0']

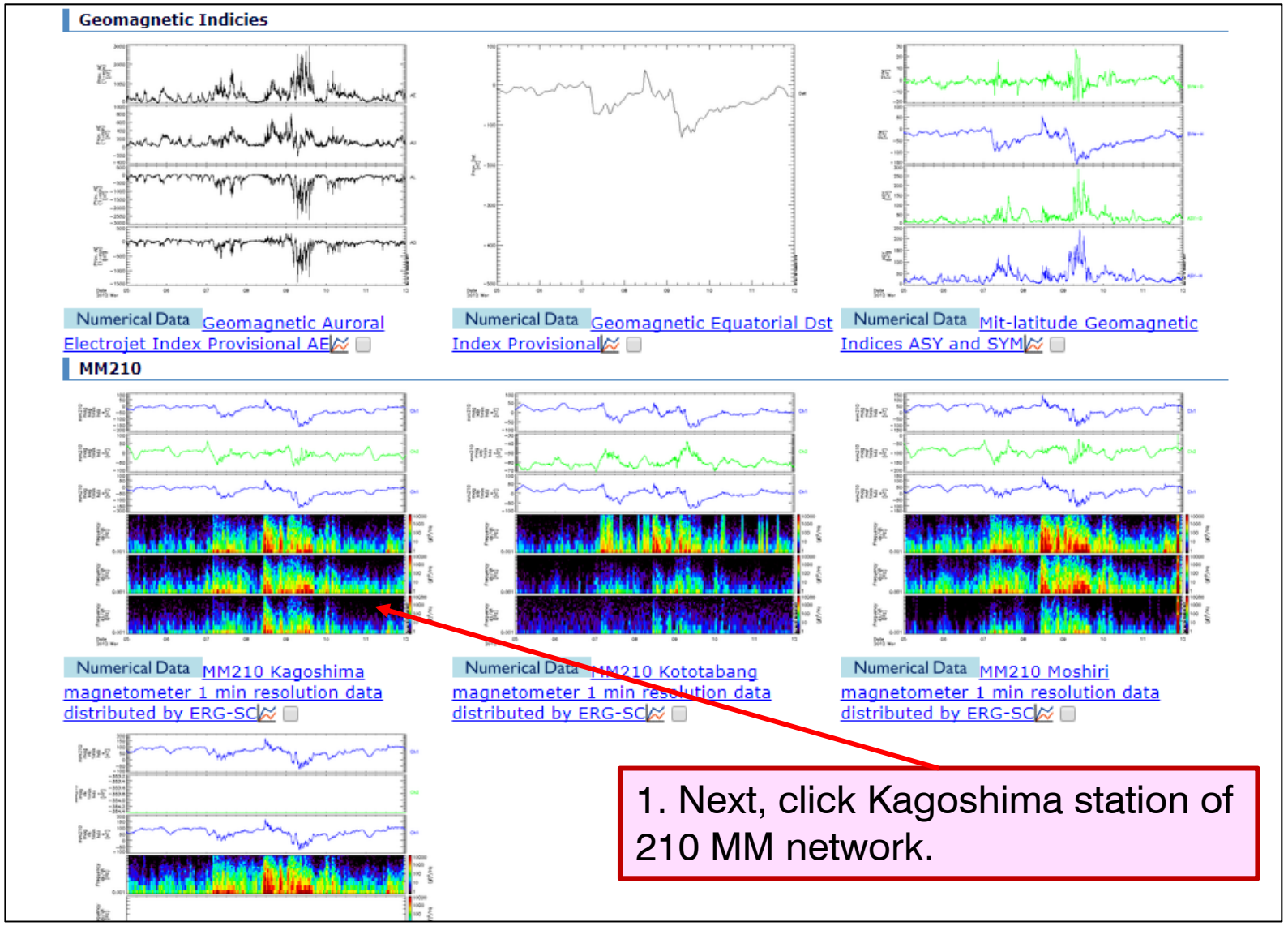
Plot Dst and AE indices only.

AU and AL shows eastward and westward auroral current, respectively. AE is a value of AU-AL (i.e., total auroral activity) and AO is the average of AU and AL.



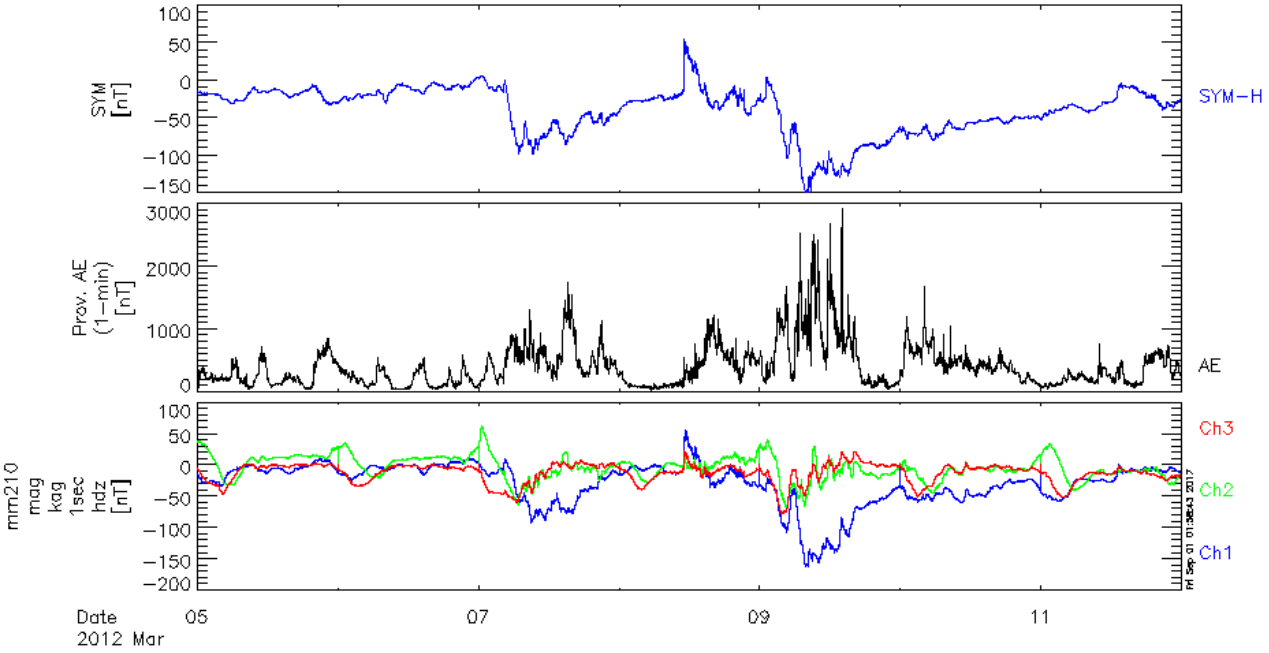
Add other magnetic data to stack plot (1)

Geomagnetic field data



Add other magnetic data to stack plot (2)

1. THEMIS> iug_load_gmag_mm210, site='kag'
   (Load magnetometer data at KAG from 210 MM network.)
2. THEMIS> tplot_names
   (Check loaded tplot variables.)
   mm210_mag_kag_1sec_hdz
   mm210_mag_kag_1min_hdz
   mm210_mag_kag_1h_hdz ← (Added magnetometer data at KAG.)
3. THEMIS> tplot, ['wdc_mag_sym_1', 'wdc_mag_ae_prov_1min_0', $
   'mm210_mag_kag_1sec_hdz']



- SYM-H index:
  An indicator of magnetic storm
- AE index:
  An indicator of auroral activity
- Magnetic field at KAG
  Ch1: North-south
  Ch2: East-west
  Ch3: Vertical

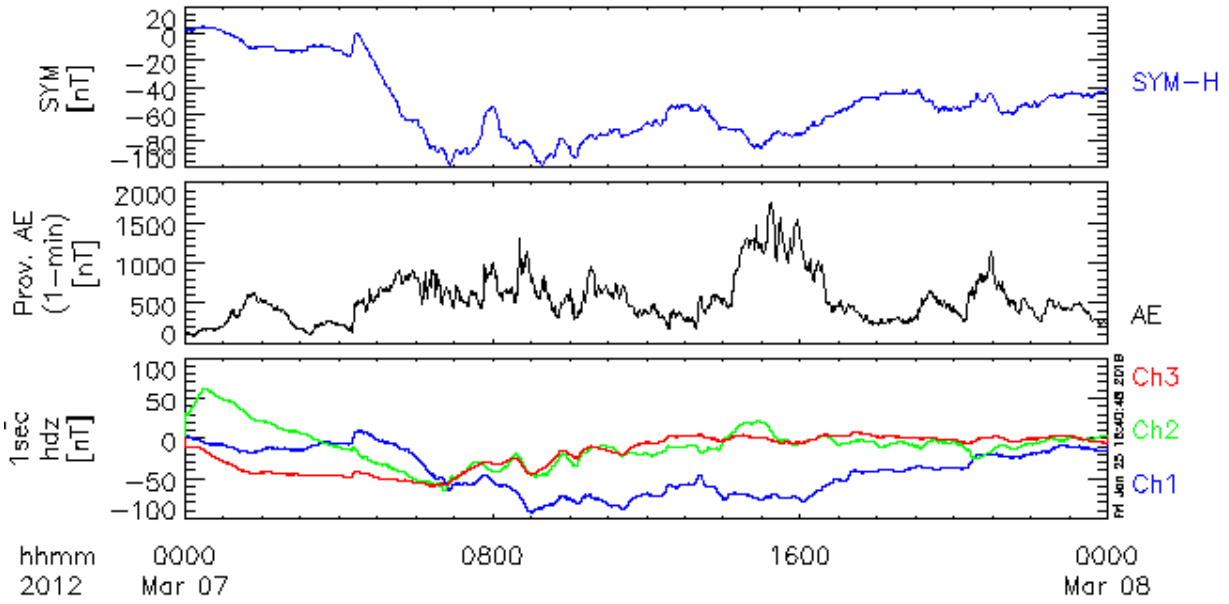
Add other magnetic data to stack plot (3)

Change limits of time interval.

tlimit, 'YYYY$_1$-MM$_1$-DD$_1$/hh$_1$:mm$_1$:ss$_1$', 'YYYY$_2$-MM$_2$-DD$_2$/hh$_2$:mm$_2$:ss$_2$'

tlimit + clicks by mouse (Set max and min limits by clicking.)
tlimit, /last (Return previous limits)
tlimit, /full (Change to full limits)

1. THEMIS> tlimit, '2012-03-07', '2012-03-08' (Change the time range.)



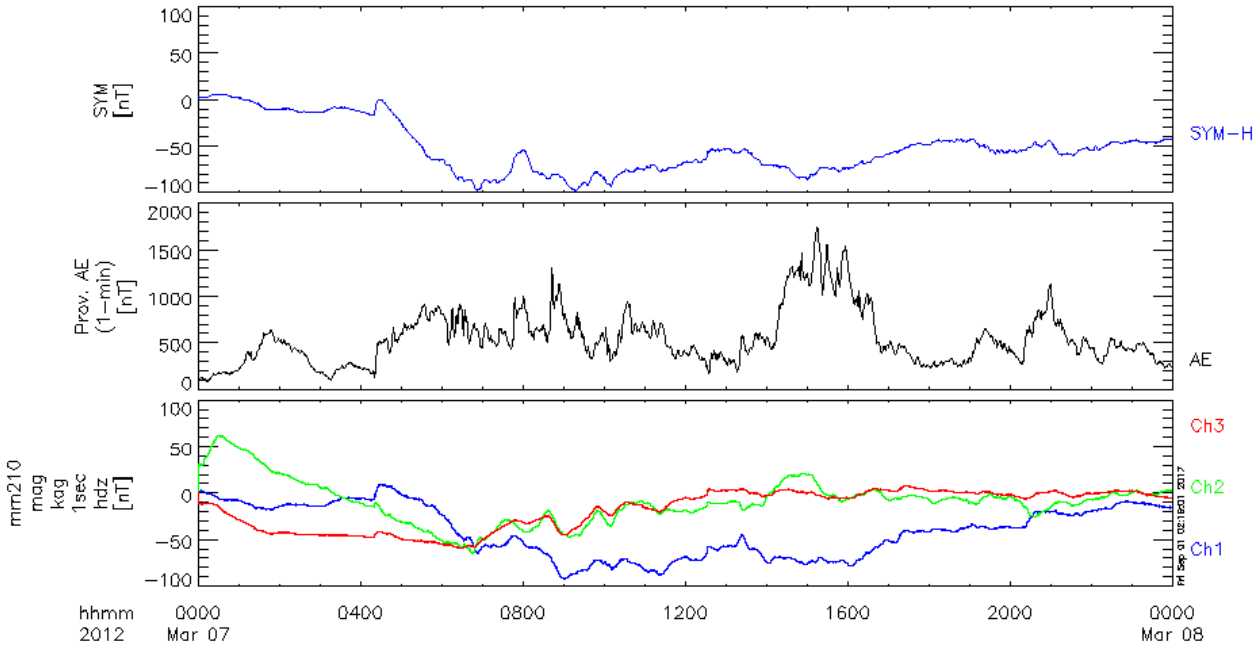
Add other magnetic data to stack plot (4)

Change limits of y axis.

ylim, 'tplot_variables', min, max (, LOG=log)

ylim, 'tplot_variables', min, max, 1 (Set y-axis to log scale.)
ylim, 'tplot_variables', min, max, 0 (Set y-axis to linear scale.)

1. THEMIS> ylim, 'wdc_mag_sym_1', -100, 100 (Set y-axis range.)
2. THEMIS> tplot



Add other magnetic data to stack plot (5)

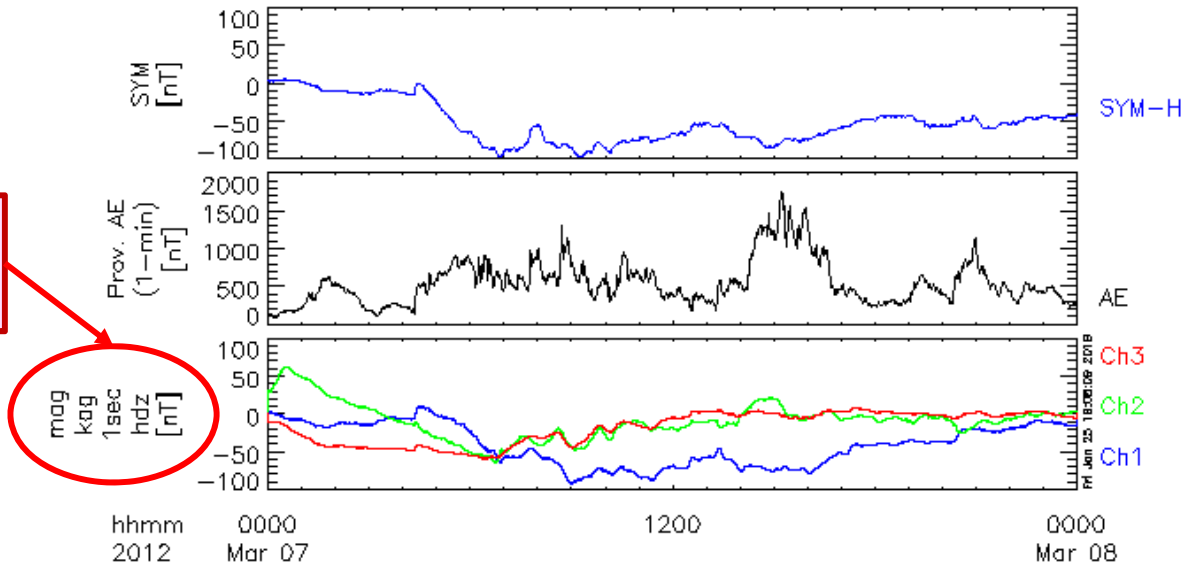
Set options for visualization of data.

tplot_options, 'tplot_variable', ‘value'

e.g., tplot_options, 'region', [x0, y0, x1, y1] (Set the region of axis position)
tplot_options, 'title', 'strings' (Set the title of plot.)
tplot_options, 'var_label', 'tplot_variable' (Add the label to the bottom.)

1. THEMIS> tplot_options, 'region', [0.05, 0, 1, 1] (Set the region of axis position.)
2. THEMIS> tplot

The Y-axis title was displayed correctly.



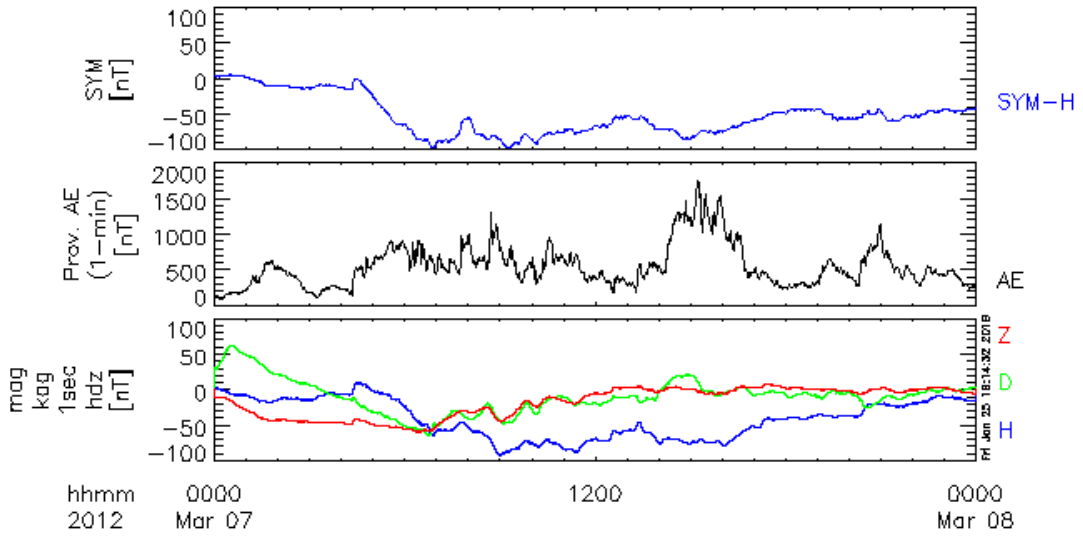
Add other magnetic data to stack plot (6)

Set options for visualization of data.

options, 'tplot_variable', ‘option_name', 'value'

e.g., options, 'tplot_variable', 'labels', 'label_strings' (Set labels for lines)
options, 'tplot_variable', 'ytitle', 'ytitle_strings' (Set y-axis title.)
options, 'tplot_variable', 'colors', value (Set colors of lines. The values are 0: black, 1: magenta, 2: blue, 3: cyan, 4: green, 5: yellow, 6: red.)

1. THEMIS> options, 'mm210_mag_kag_1sec_hdz', 'labels', ['H', 'D', 'Z']
(Change the labels of 'mm210_mag_kag_1sec_hdz'.)
2. THEMIS> tplot



Data analysis of tplot_variable (FFT) (1)

"How to Plot" display of magnetometer data at KAG

```
How to Plot (SPEDAS-CUI #Basic):
IDL>      thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_mm210, site='kag', datatype='1min'
THEMIS> tplot, 'mm210_mag_kag_1min_hdz'

How to Plot (SPEDAS-CUI #Advanced [*Quick-Look was created with this command]):
IDL>      thm_init
THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
THEMIS> iug_load_gmag_mm210, site='kag', datatype='1min'
THEMIS> tdpwrspc, 'mm210_mag_kag_1min_hdz', nboxpoints=128, nshiftpoints=8
THEMIS> ylim, 'mm210_mag_kag_1min_hdz_x_dpwrspc', 0.001, 0.008
THEMIS> ylim, 'mm210_mag_kag_1min_hdz_y_dpwrspc', 0.001, 0.008
THEMIS> ylim, 'mm210_mag_kag_1min_hdz_z_dpwrspc', 0.001, 0.008
THEMIS> zlim, 'mm210_mag_kag_1min_hdz_x_dpwrspc', 0.5, 10000
THEMIS> zlim, 'mm210_mag_kag_1min_hdz_y_dpwrspc', 0.5, 10000
THEMIS> zlim, 'mm210_mag_kag_1min_hdz_z_dpwrspc', 0.5, 10000
THEMIS> options, 'mm210_mag_kag_1min_hdz_x_dpwrspc', 'ytitle', 'Frequency!Cdx/dt'
THEMIS> options, 'mm210_mag_kag_1min_hdz_y_dpwrspc', 'ytitle', 'Frequency!Cdy/dt'
THEMIS> options, 'mm210_mag_kag_1min_hdz_z_dpwrspc', 'ytitle', 'Frequency!Cdz/dt'
THEMIS> options, 'mm210_mag_kag_1min_hdz_x_dpwrspc', 'ysubtitle', '[Hz]'
THEMIS> options, 'mm210_mag_kag_1min_hdz_y_dpwrspc', 'ysubtitle', '[Hz]'
THEMIS> options, 'mm210_mag_kag_1min_hdz_z_dpwrspc', 'ysubtitle', '[Hz]'
THEMIS> tplot_options, 'region', [0.05, 0, 1, 1]
THEMIS> tplot, ['mm210_mag_kag_1min_hdz_x', 'mm210_mag_kag_1min_hdz_y', 'mm210_mag_kag_1min_hdz_x',
          'mm210_mag_kag_1min_hdz_x_dpwrspc', 'mm210_mag_kag_1min_hdz_y_dpwrspc',
          'mm210_mag_kag_1min_hdz_z_dpwrspc']

How to Plot (SPEDAS-GUI):
Step 1:   Start SPEDAS GUI Program.
Step 2:   Choose [FILE] -> [Load Data].
Step 3:   Choose [IUGONET] Tab.
Step 4:   Uncheck 'Use Single Day'.
Step 5:   Set Start Time: '2012-03-05 00:00:00' and Stop Time: '2012-03-12 00:00:00'.
Step 6:   Choose Instrument Type: 'geomagnetic_field_fluxgate'.
Step 7:   Choose Data Type: '210mm#', Site or parameter(s)-1: 'kag' and parameter(s)-2: '1min'.
Step 8:   Push [->] button. (Please wait a few minutes).
Step 9:   Push [Done] button.
Step 10:  Choose [Graph] -> [Plot Layout Options].
Step 11:  Choose 'mm210_mag_kag_1min_hdz' and push [Line->] button.
Step 12:  Push [OK] button.
```

CUI #Advanced:
You can find how to analyze data here.

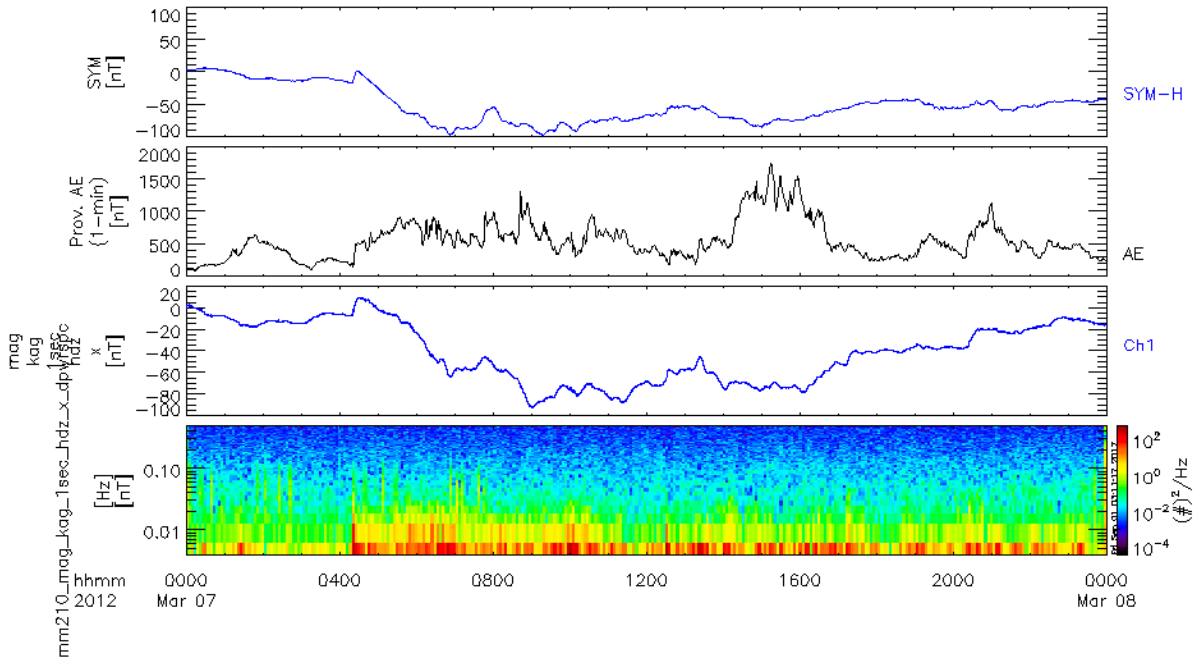
Data analysis of tplot_variable (FFT) (2)

Apply the FFT method to the magnetometer data at KAG

tdpwrspc, 'tplot_variable', nboxpoints=nfft, nshiftpoints=nshift

(nboxpoints: number of FFT points. nshiftpoints: number of shift points.)

1. THEMIS> tdpwrspc, 'mm210_mag_kag_1sec_hdz', nboxpoints=512, nshiftpoints=256 (Apply FFT to the magnetometer data at KAG)
2. THEMIS> tplot_names
3. THEMIS> tplot, ['wdc_mag_sym_1', 'wdc_mag_ae_prov_1min_0', 'mm210_mag_kag_1sec_hdz_x', 'mm210_mag_kag_1sec_hdz_x_dpwrspc']



Convenient function for tplot_variables (1)

Calculate the sum of two tplot variables.

add_data, 'tplot_variable1', 'tplot_variable2'

Calculate the difference of two tplot variables.

dif_data, 'tplot_variable1', 'tplot_variable2'

Calculate the product of two tplot variables.

mult_data, 'tplot_variable1', 'tplot_variable2'

Calculate the division of two tplot variables (“tplot_variable1”/”tplot_variable2”)

div_data, 'tplot_variable1', 'tplot_variable2'

Calculate the average of a tplot variable over time of res(s).

avg_data, 'tplot_variable', res

Calculate the derivation of a tplot variable.

deriv_data, 'tplot_variable'

Convenient function for tplot_variables (2)

- Interpolate “tplot_variable1” using time of “tplot_variable2”.

  tinterpol, ‘tplot_variable1’, ‘tplot_variable2’

- Smooth “tplot_variable” by running average with a time window of dt(s).

  tsmooth_in_time, 'tplot_variable', dt

- Apply the high-pass filter of dt(s) to “tplot_variable”.

  thigh_pass_filter, 'tplot_variable', dt

- Subtract average value from “tplot_variable”.

  tsub_average, 'tplot_variable' (, /median)

- Calculate dynamic spectrum of “tplot_variable”

  tdpwrspc, 'tplot_variable', nboxpoints=nbx, nshiftpoints=nsp

Convenient function for tplot_variables (3)

Replace values of “tplot_variable” outside of limits with NaN.

```
tclip, 'tplot_variable', amin, amax
```

Interpolate data for NaN and Inf in “tplot_variable”.

```
tdeflag, 'tplot_variable' , 'linear'
```

Replace data gap (margin+dt ~ maxgap*dt) in “tplot_variable” with NaN.

```
tdegap, 'tplot_variable', maxgap=maxgap, margin=margin
```

Remove spike noise from “tplot_variable”.

```
clean_spikes, 'tplot_variable'
```

Calculate dynamic spectrum of “tplot_variable” by wavelet transform.

```
wav_data, 'tplot_variable'
```

Convert between “tplot variables” and IDL variables (1)

Retrieve data or limit structure from “tplot_variable”.

```
get_data, 'tplot_variable', data=d, dlimits=dlim, lim=lim
```

data structure　　default limits structure　　limits structure

```
1. THEMIS> get_data, 'mm210_mag_kag_1sec_hdz', data=d, dlimits=dl, lim=lim
2. THEMIS> help, d, /struct    (Check data structure.)
** Structure <17ac3700>, 2 tags, length=12096000, data length=12096000, refs=1:
   X               DOUBLE    Array[604800]          (Time : 1 dimension)
   Y               FLOAT     Array[604800, 3]       (Magnetic field vector : 2 dimension)

3. THEMIS> help, dl, /struct    (Check default limits structure.)
** Structure <1ab92dd0>, 4 tags, length=1256, data length=1250, refs=2:
   CDF             STRUCT    -> <Anonymous> Array[1]
   SPEC            BYTE      0
   LOG             BYTE      0
   YSUBTITLE       STRING    '[nT]'

4. THEMIS> help, lim, /struct    (Check limits structure.)
** Structure <e3fa9f0>, 3 tags, length=64, data length=56, refs=2:
   COLORS          INT       Array[3]
   LABELS          STRING    Array[3]
   LABFLAG         INT       1
```

Convert between “tplot variables” and IDL variables (2)

Create “tplot variable” from data structure and limits structures.

store_data, ‘tplot_variable’, data={x:time, y:val}, dlimits=dlim, lim=lim

time: unix time (number of seconds since 1970-01-01UT)
val: data array

1. THEMIS> time = d.x (Substitute time to IDL variable, “time”.)

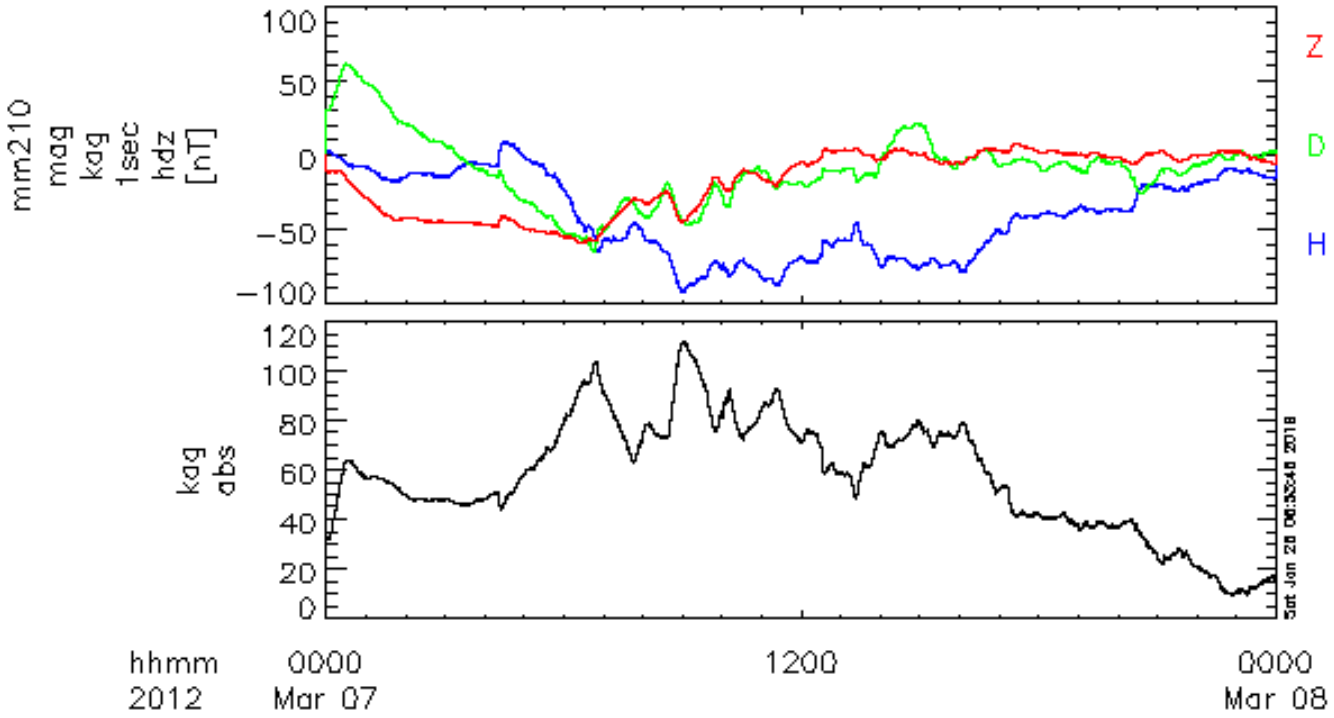
2. THEMIS> val = sqrt(d.y[*, 0]^2 + d.y[*, 1]^2 + d.y[*, 2]^2)
(Calculate the absolute value of the magnetic field,
sqrt(Bx^2 + By^2 +Bz^2) and substitute it to “val”)

3. THEMIS> store_data, 'kag_abs', data = { x:time, y:val }

4. THEMIS> tplot_names

5. THEMIS> tplot, ['mm210_mag_kag_1sec_hdz', 'kag_abs']

Convert between “tplot variables” and IDL variables (3)



Calculation of “tplot variables” by calc (1)

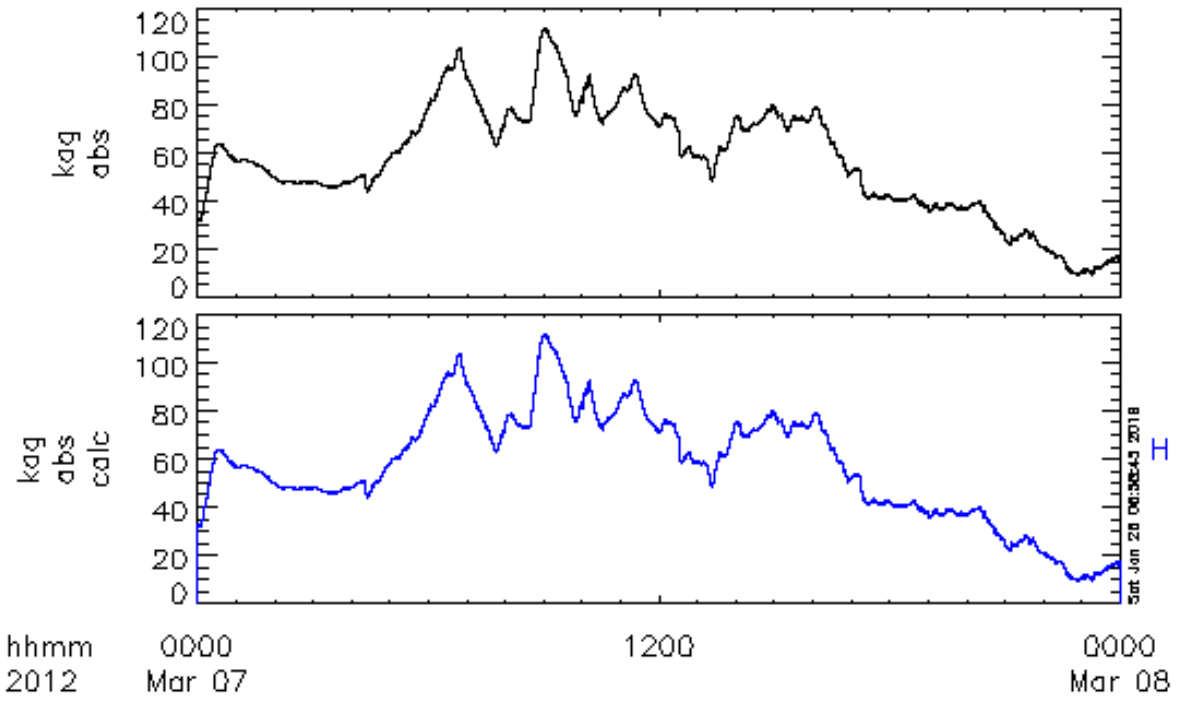
Calculate using “tplot_variables“ by “calc”.

calc, 'equation'

- Whole of the equation is enclosed by single quotations (').
- “tplot_variables” are enclosed by double quotations (”).
- Many functions, such as sin(), cos(), tan(), exp(), log(), abs(), min(), max(), total(), mean(), median() are available.

```
1. THEMIS> calc, ' "kag_abs_calc" =  $
                  sqrt( "mm210_mag_kag_1sec_hdz_x" ^ 2 +  $
                        "mm210_mag_kag_1sec_hdz_y" ^ 2 +  $
                        "mm210_mag_kag_1sec_hdz_z" ^ 2) '
2. THEMIS> tplot, ['mm210_mag_kag_1sec_hdz ', 'kag_abs', 'kag_abs_calc']
```

Calculation of “tplot variables” by calc (2)



Create an image file

Create an image file from the currently displayed image.

makepng, 'filename' (Create PNG file)

makejpg, 'filename' (Create JPEG file)
makegif, 'filename' (Create GIF file)
popen, 'filename' (Open postscript file.)
pclose (Close postscript file opened with popen.)

1. THEMIS> makepng, 'Figure_test' (Create PNG file, “Figure_test.png”)
2. THEMIS> makejpg, 'Figure_test' (Create JPEG file, “Figure_test.jpeg”)
3. THEMIS> makegif, 'Figure_test' (Create GIF file, “Figure_test.gif”)

4. THEMIS> popen, 'Figure_test'
   (Change plot device to postscript and open a file, “Figure_test.ps”.)
5. THEMIS> tplot (Plot data)
6. THEMIS> pclose (Close the postscript file and change device back to default.)

Create an ascii file

Create an ascii file for selected “tplot variable”.

tplot_ascii, 'tplot_variable' (, fname=‘filename‘)

Save “tplot variable” in a binary file.

tplot_save, 'tplot_variables', filename='filename'

Restore “tplot variable” saved with “tplot_save”.

tplot_restore, filename='filename'

1. THEMIS> tplot_ascii, 'mm210_mag_kag_1h_hdz'
   (Save an ascii file named “mm210_mag_kag_1h_hdz.txt” in a current directry.)

Data in the “mm210_mag_kag_1h_hdz.txt”:

```
2012-03-05/00:00:00.000    -2.2200001e+001    3.5100002e+001    -1.2900001e+001
2012-03-05/01:00:00.000    -2.8200001e+001    2.8100000e+001    -2.5600000e+001
…..
```

2. THEMIS> tplot_save, 'mm210_mag_kag_1h_hdz'
   (Save a binary file named “saved.tplot” in a current directry.)
3. THEMIS> store_data, 'mm210_mag_kag_1h_hdz', /delete
   (Delete 'mm210_mag_kag_1h_hdz' from memory.)
4. THEMIS> tplot_names (Confirm that 'mm210_mag_kag_1h_hdz‘ was deleted.)
5. THEMIS> tplot_restore,filename='saved.tplot' (Restore the saved tplot variable.)

Examples of Application

Plot solar wind parameters and geomagnetic indices (1)

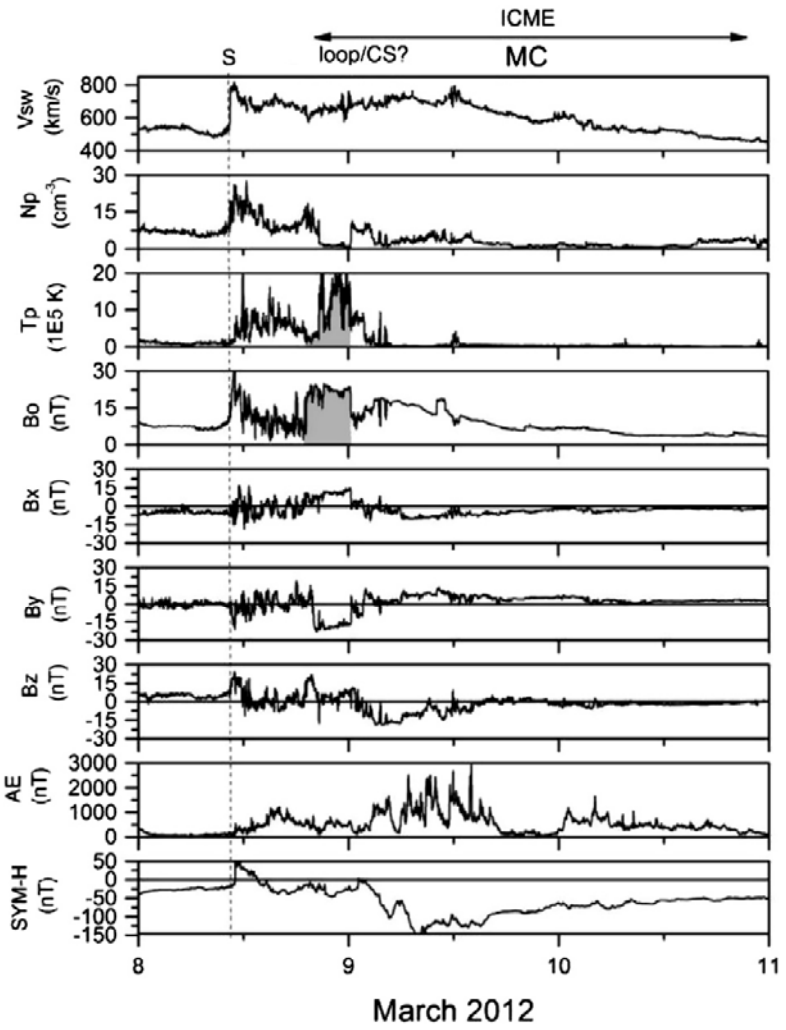


Figure 3. Event S2, 9 March. The storm is caused by the southward field component of a MC. An unusually intense SI^+ is associated with a strong shock leading the MC. There may be a coronal loop/ coronal sheath detected within the interplanetary (ICME) event (shaded).

Tsurutani et al. (2014), J. Space Weather Space Clim., 4, A02, DOI: 10.1051/swsc/2013056.

Characteristics of solar wind and geomagnetic activity on 3 March 2012:

- ✓ Geomagnetic storm (max. Dst = -148 nT) is caused by negative IMF-Bz associated with the magnetic cloud (MC).
- ✓ Extremely high temperature region (T~ 20*10^5K) passed through the upstream and downstream of interplanetary shock the period from 11:30UT on 8 March to 01:50UT on 9 March (Coronal loop or coronal sheath?).
- ✓ SI+ observed at 11:30UT on 8 March is very strong (~60nT).

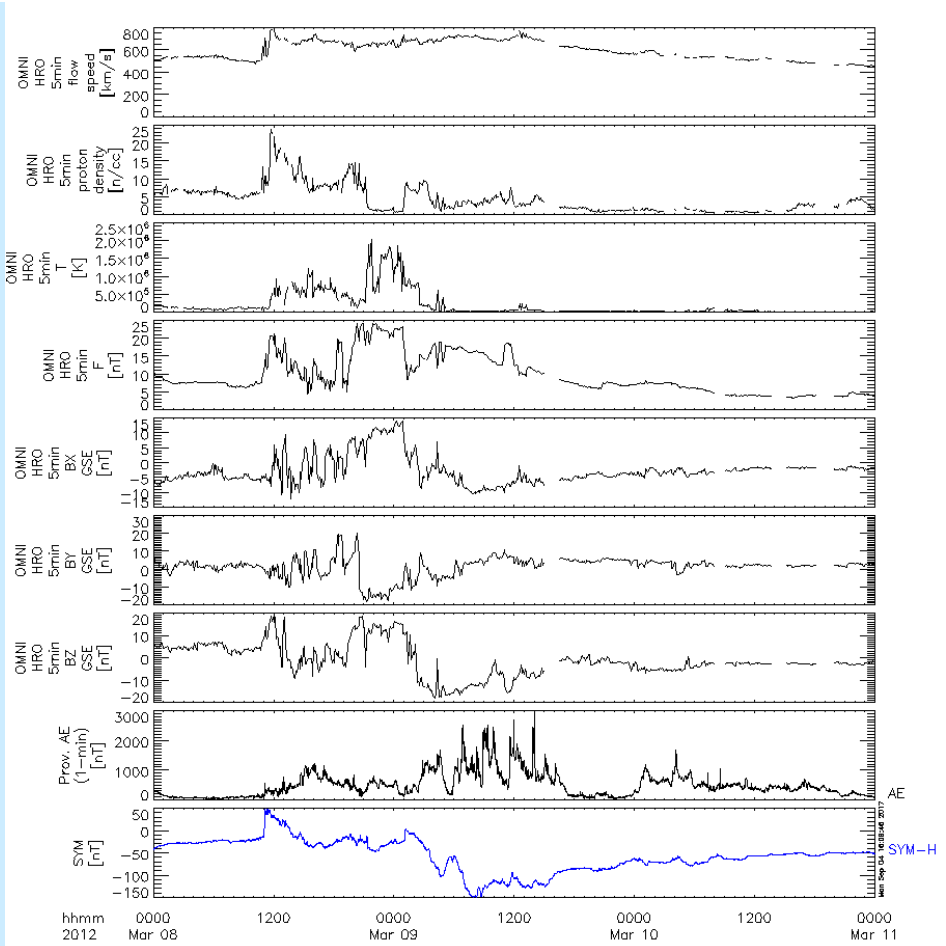
Plot solar wind parameters and geomagnetic indices (2)

1. THEMIS> timespan, '2012-03-08', 3 (Set timespan to 3 days from 2012-03-08.)
2. THEMIS> omni_load_data, /res5min (Load OMNI data.)

3. THEMIS> tplot_names
   (Check the loaded data.)

4. THEMIS> tplot,
   ['OMNI_HRO_5min_flow_speed',
   'OMNI_HRO_5min_proton_density',
   'OMNI_HRO_5min_T',
   'OMNI_HRO_5min_F',
   'OMNI_HRO_5min_BX_GSE',
   'OMNI_HRO_5min_BY_GSE',
   'OMNI_HRO_5min_BZ_GSE',
   'wdc_mag_ae_prov_1min_0',
   'wdc_mag_sym_1']

5. THEMIS> ylim, 'wdc_mag_sym_1',
   -150, 50
6. THEMIS> tplot

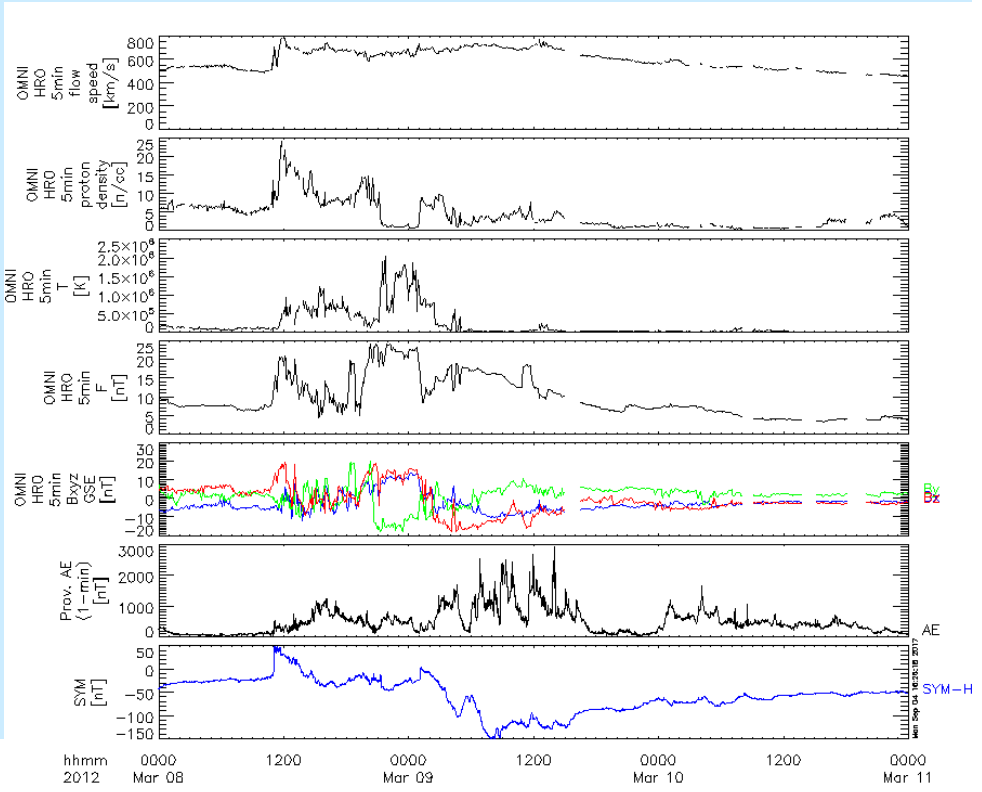


Plot solar wind parameters and geomagnetic indices (3)

1. THEMIS> options, 'OMNI_HRO_5min_BX_GSE', labels='Bx', colors=2
2. THEMIS> options, 'OMNI_HRO_5min_BY_GSE', labels='By', colors=4
3. THEMIS> options, 'OMNI_HRO_5min_BZ_GSE', labels='Bz', colors=6
   (Set colors and labels for IMF-Bx, By, Bz (2:blue, 4:green, 6:red).)
4. THEMIS> store_data, 'OMNI_HRO_5min_Bxyz_GSE',
   data=['OMNI_HRO_5min_BX_GSE', 'OMNI_HRO_5min_BY_GSE',
   'OMNI_HRO_5min_BZ_GSE']

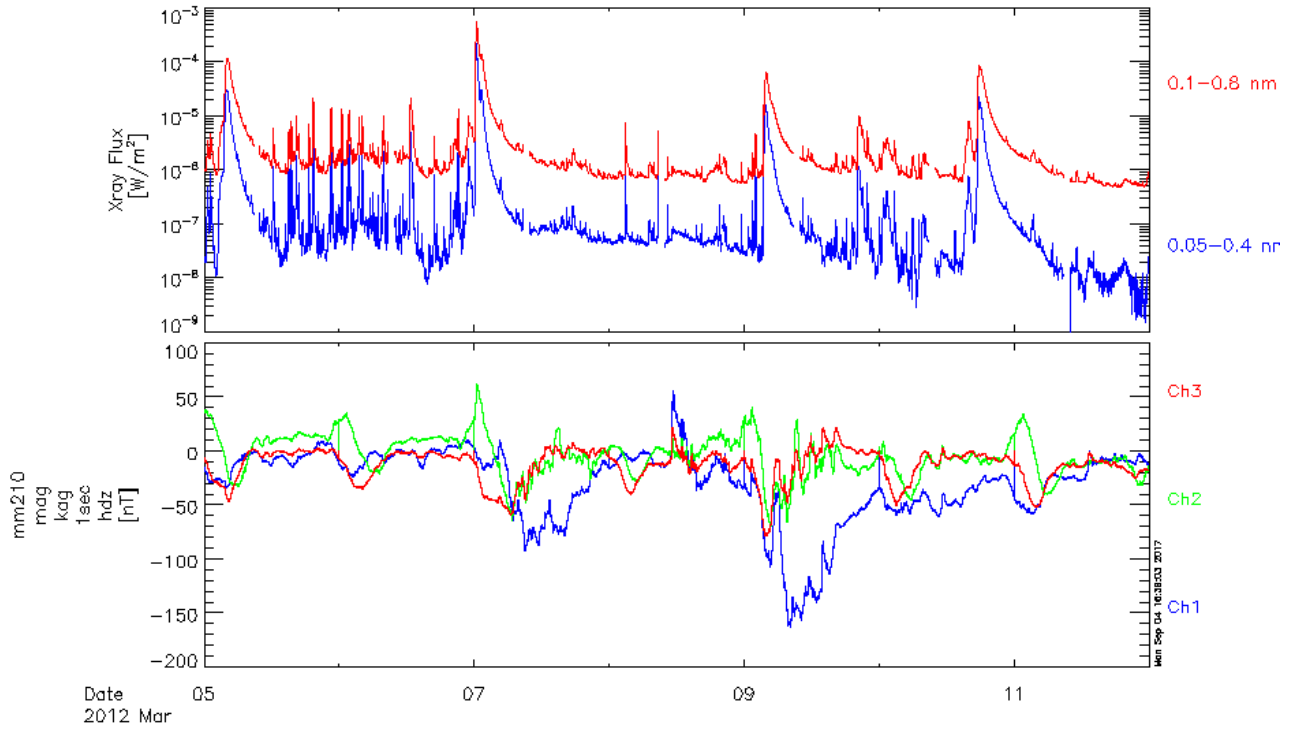
(Store the IMF-Bx, By, Bz vector into "OMNI_HRO_5min_Bxyz_GSE")

5. THEMIS> tplot,
['OMNI_HRO_5min_flow_speed',
'OMNI_HRO_5min_proton_density',
'OMNI_HRO_5min_T',
'OMNI_HRO_5min_F',
'OMNI_HRO_5min_Bxyz_GSE',
'wdc_mag_ae_prov_1min_0',
'wdc_mag_sym_1']



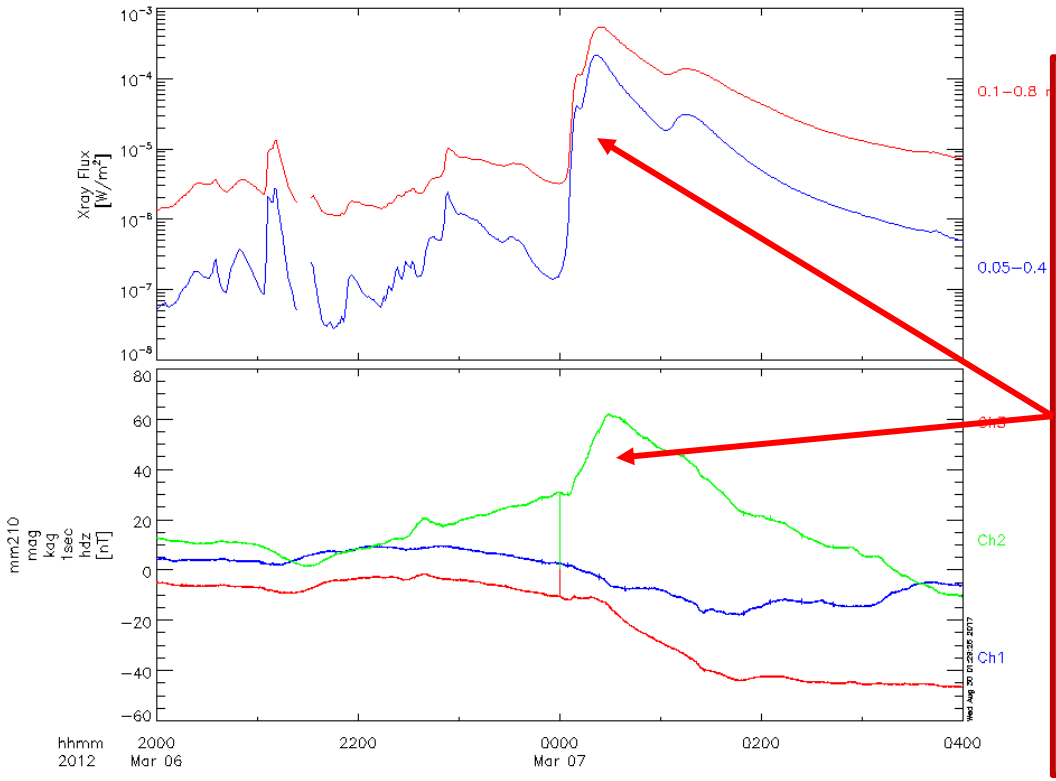
Compare GOES X-ray flux with geomagnetic field (1)

1. THEMIS> timespan, ['2012-03-05 00:00:00', '2012-03-12 00:00:00']
   (Set timespan.)
2. THEMIS> goes_load_data, probes='15', datatype='xrs', /avg_1m
   (Load 1min-averaged X-ray flux data from the GOES-15.)
3. THEMIS> tplot, ['g15_xrs_avg', 'mm210_mag_kag_1sec_hdz']
   (Plot the GOES X-ray flux and magnetometer data at KAG.)



Compare GOES X-ray flux with geomagnetic field (2)

1. THEMIS> tlimit, '2012-03-06/20', '2012-03-07/04'
(Change the time range to find a good correlation between X-ray flux and geomagnetic field.)



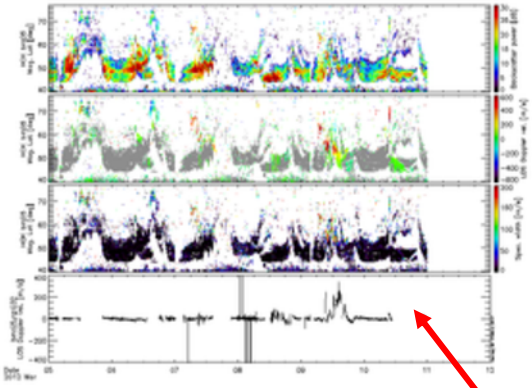
Solar Flare Event (SFE)

The east-west component of the magnetic field shows large variation when the X-class flare occurred.

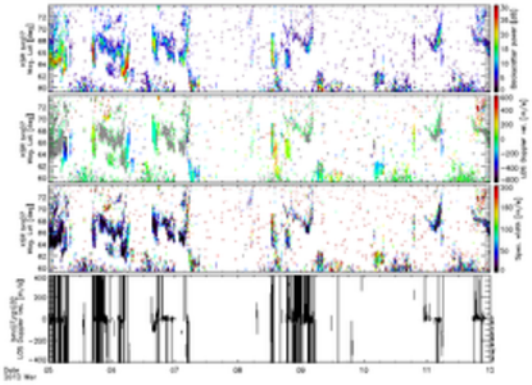
It is interpreted that the ionospheric conductivity was enhanced by the increase in the X-ray flux.

Plot SuperDARN radar data (1)

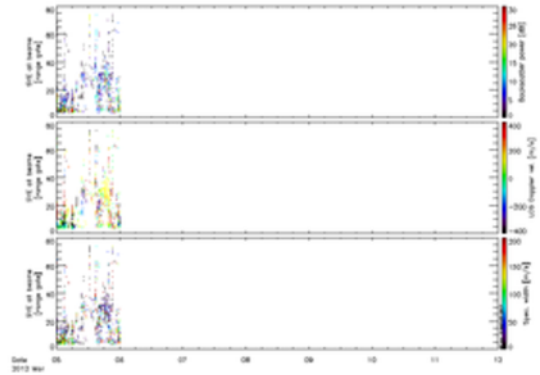
SuperDARN



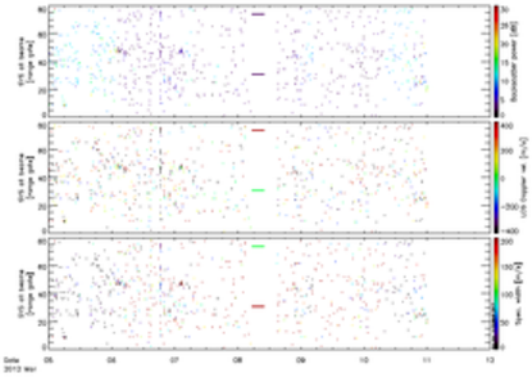
Numerical Data The common time fitacf CDF data of SuperDARN Hokkaido East HF radar distributed by ERG-SC



Numerical Data The common time fitacf CDF data of SuperDARN King Salmon HF radar distributed by ERG-SC



Numerical Data The common time fitacf data of SENSU SuperDARN Syowa East HF radar distributed by ERG-SC

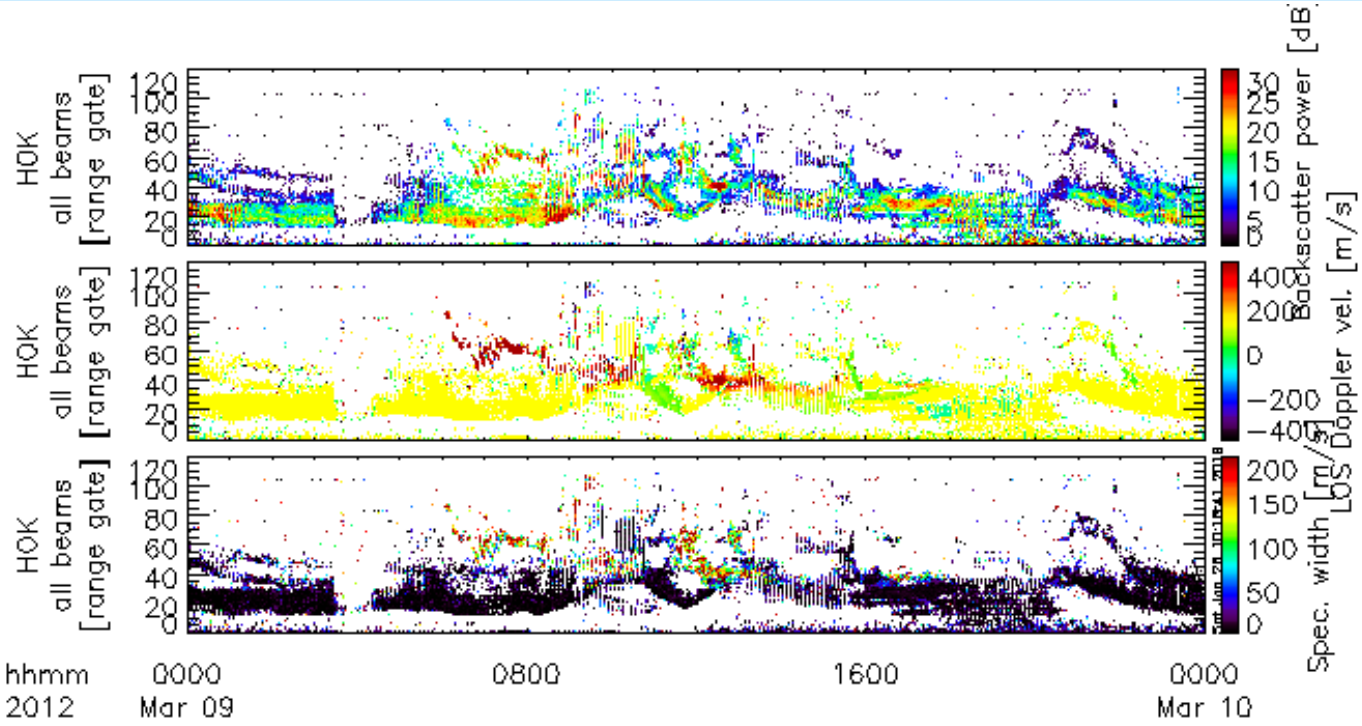


Numerical Data The common time fitacf data of SENSU SuperDARN Syowa South HF radar distributed by ERG-SC

You can find how to load and plot data from SuperDARN Hokkaido East radar by using IUGONET Type-A

Plot SuperDARN radar data (2)

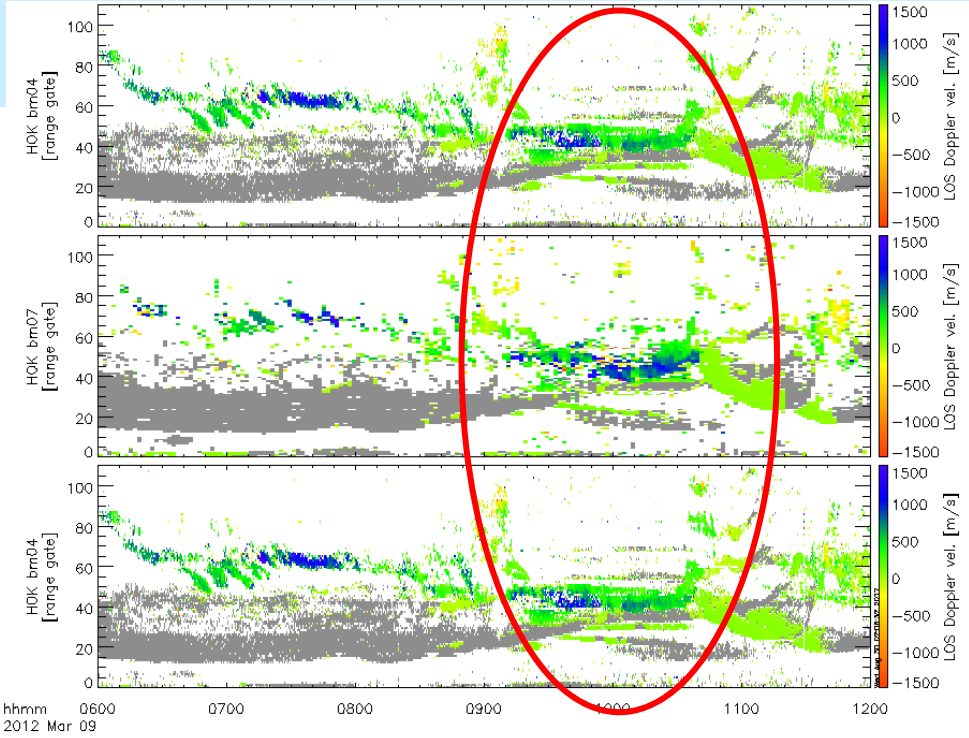
1. THEMIS> timespan, '2012-03-09' (Set timespan.)
2. THEMIS> iug_load_sdfit, site='hok'
   (Load SuperDARN radar data at HOK.)
3. THEMIS> tplot_names (Check loaded data.)
4. THEMIS> tplot, ['sd_hok_pwr_1', 'sd_hok_vlos_bothscat_1',
   'sd_hok_spec_width_1']
   (Plot the echo power, line-of-sight(LOS) Doppler velocity, spectral width.)



Plot SuperDARN radar data (3)

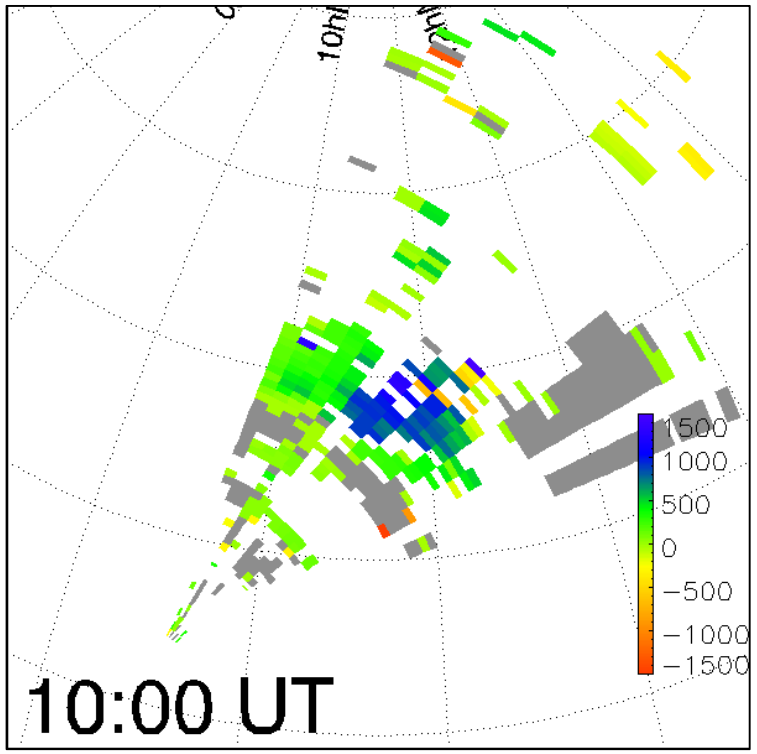
1. THEMIS> splitbeam, 'sd_hok_vlos_bothscat_1'
   (Split LOS plasma velocity into each beam.)
2. THEMIS> loadct_sd, 44
   (Change color table for the LOS Doppler velocity of SD radar.)
3. THEMIS> tplot, ['sd_hok_vlos_bothscat_1_azim04',
   'sd_hok_vlos_bothscat_1_azim07', 'sd_hok_vlos_bothscat_1_azim10']
4. THEMIS> tlimit, '2012-03-09/06', '2012-03-09/12'
5. THEMIS> zlim, 'sd_hok_vlos_bothscat_1_*', -1500, 1500
6. THEMIS> tplot

Strong westward flow (>1000m/s) associated with **SAPS (Sub-Auroral Polarization Stream)** can be found just after the minimum peak of Dst.



Plot SuperDARN radar data (4)

1. THEMIS> window, 1, xsize=600, ysize=600 & erase
2. THEMIS> sd_init (Initialize for SD tool.)
3. THEMIS> sd_time, 1000 (Set time for 2D plot to 10:00UT.)
4. THEMIS> sd_map_set, /erase, /clip, /mltlabel, center_glat=60, center_glon=160
   (Set map for 2D plot.)
5. THEMIS> overlay_map_sdfit, 'sd_hok_vlos_1'
   (Plot the LOS velocity on the map.)



Set color table

Set color table.

loadct2, value

options, ‘tplot_variable', ‘color_table’, value
(Set color table separately for each “tplot_variable”)

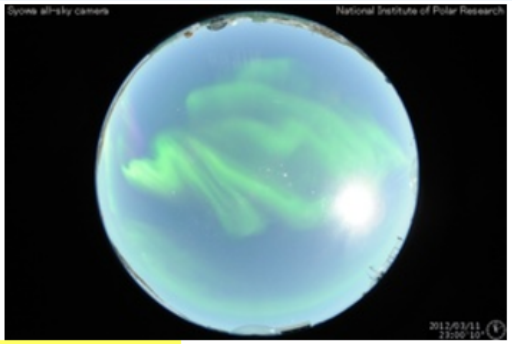
1. THEMIS> loadct2, 0 (Black-White)
2. THEMIS> loadct2, 43 (First-Special. Default for SPEDAS.)

3. THEMIS> options, 'sd_hok_pwr_1', 'color_table', 0 (Black-White)
4. THEMIS> options, 'sd_hok_vlos_bothscat_1', 'color_table', 43 (Fast-Special)
5. THEMIS> options, 'sd_hok_spec_width_1', 'color_table', 43 (Fast-Special)
6. THEMIS> tplot, ['sd_hok_pwr_1', 'sd_hok_vlos_bothscat_1',
'sd_hok_spec_width_1']

Plot EISCAT radar data (1)

Imager

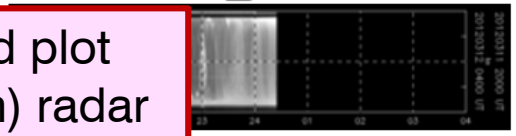
Plot/Movie Data All-sky auroral image taken by the Color Digital SLR Camera at Longyearbyen, Svalbard, Norway.



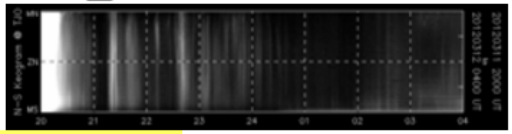
Plot/Movie Data All-sky auroral image taken by the Color Digital SLR Camera at Syowa Station, Antarctica.

Plot/Movie Data All-sky auroral image taken by the Color Digital SLR Camera at Tromso, Norway.

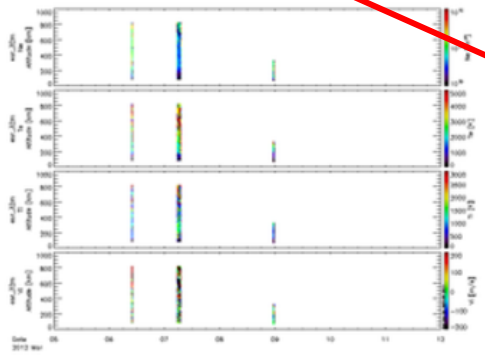
You can find how to load and plot data from EISCAT (ESR-42m) radar by using IUGONET Type-A.



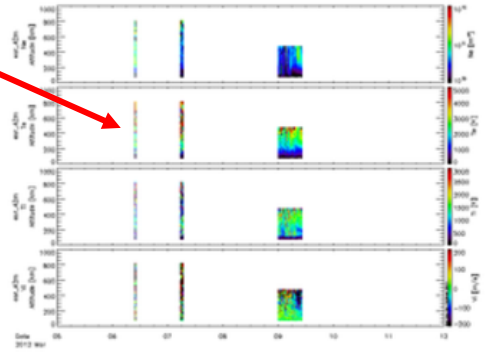
All-sky auroral image taken
t all-sky camera at Syowa
Station, Antarctica.



Plot/Movie Data All-sky auroral image taken by the white-light all-sky camera at Tjornes, Iceland.



Numerical Data Basic parameters obtained by the 32m ESR



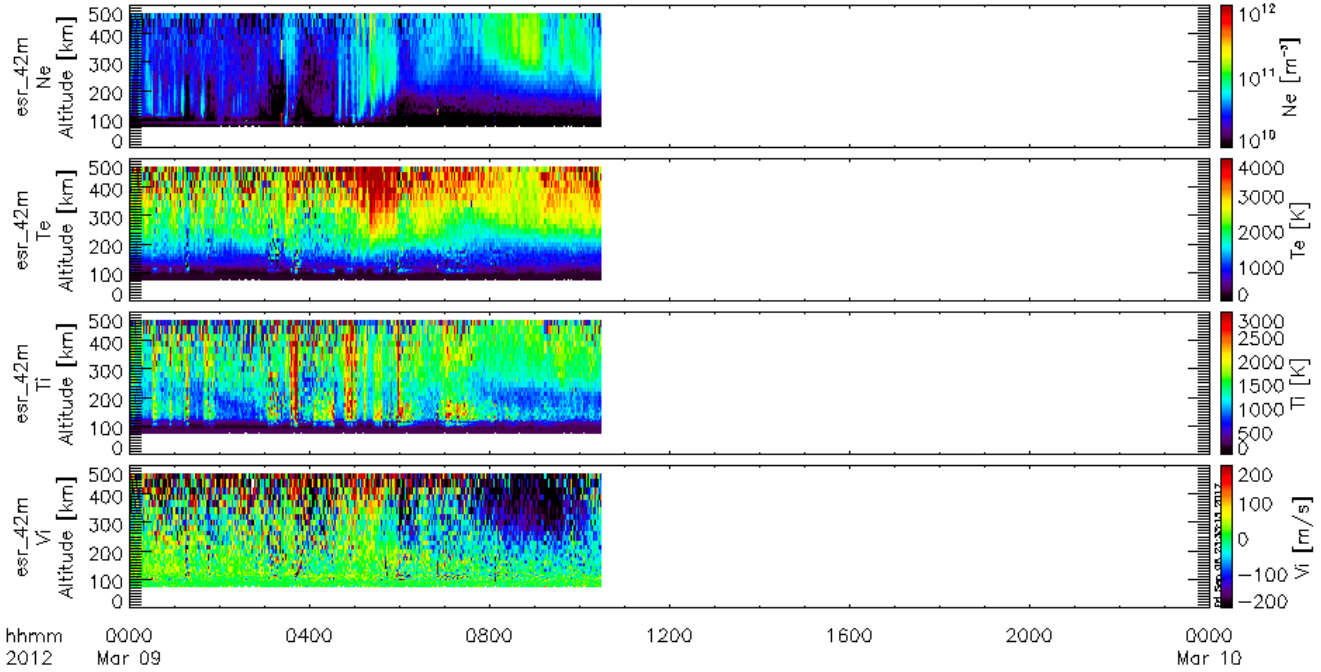
Numerical Data Basic parameters obtained by the 42m ESR

Plot/Movie Data Observation data taken by the visible all-sky camera at Shigaraki MU Observatory

Plot EISCAT radar data (2)

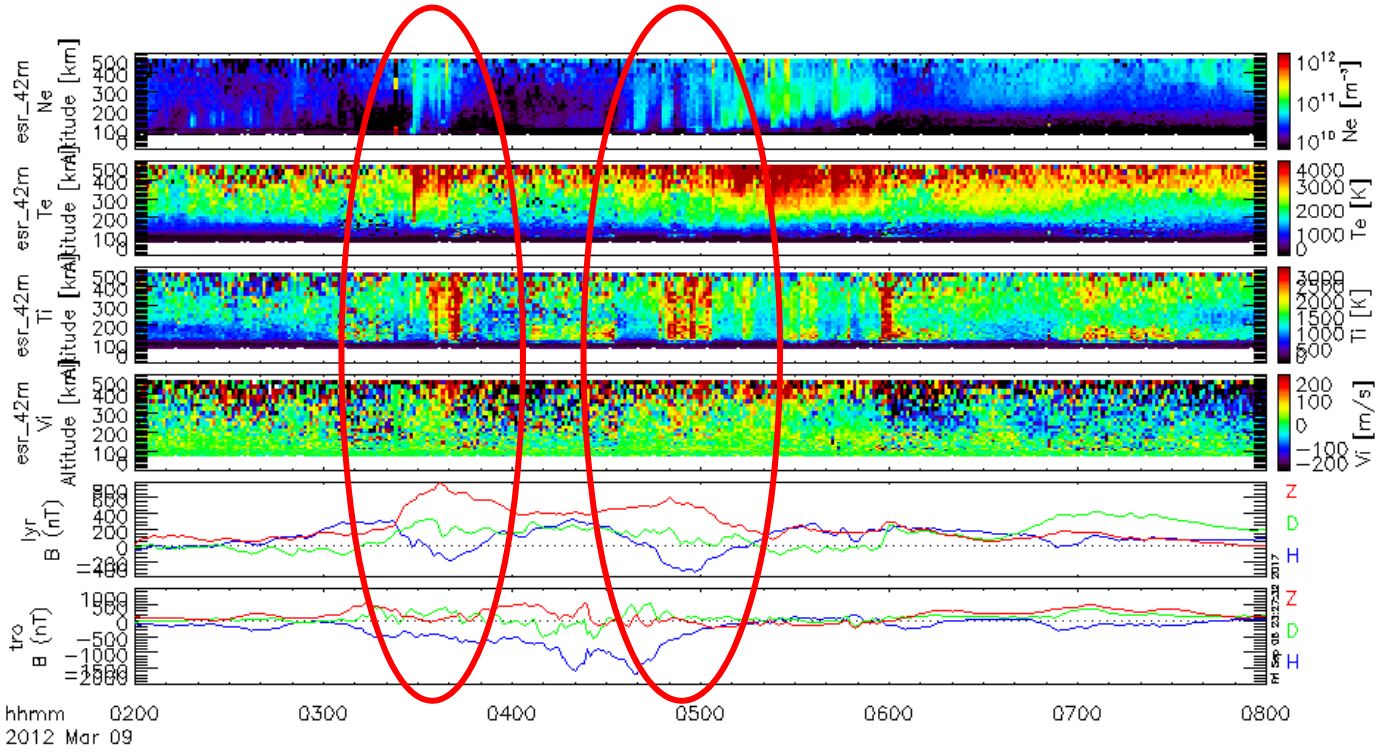
1. THEMIS> timespan, '2012-03-09' (Set timespan.)
2. THEMIS> iug_load_eiscat, site='esr_42m'
   (Load ESR 42m-antenna data.)
3. THEMIS> tplot, ['eiscat_esr42m_ne', 'eiscat_esr42m_te',
   'eiscat_esr42m_ti', 'eiscat_esr42m_vi']

(Plot basic ionospheric parameters, i.e., electron density, electron temperature, ion temperature and ion velocity.)



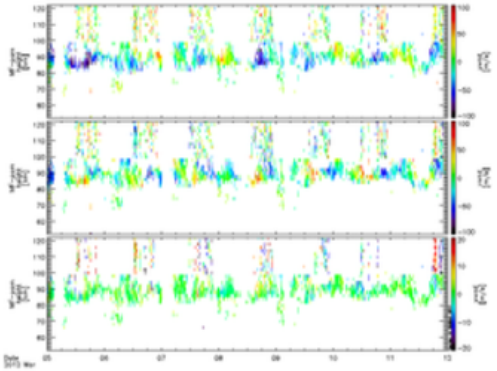
Plot EISCAT radar data (3)

1. THEMIS> thm_load_gmag, site='lyr tro', /subtract_average
   (Load the magnetic field at Longyearbyen and Tromso.)
2. THEMIS> tplot, ['eiscat_esr42m_ne', 'eiscat_esr42m_te',
   'eiscat_esr42m_ti', 'eiscat_esr42m_vi',
   'thg_mag_lyr', 'thg_mag_tro']
   (Plot both EISCAT radar and magnetometer data.)
3. THEMIS> tlimit, '2012-03-09/2', '2012-03-09/8'



Plot meteor radar data (1)

MF Radar

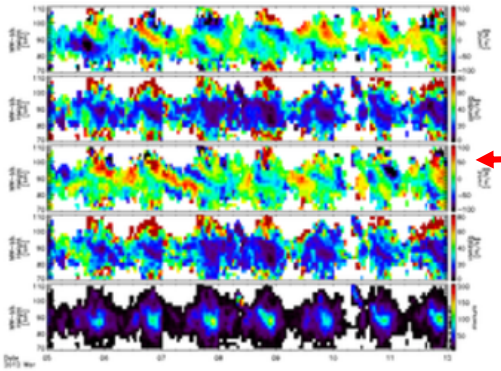


Numerical Data Wind data in the equatorial mesosphere and lower thermosphere estimated from the MF radar observations at Pameungpeuk (NetCDF format)

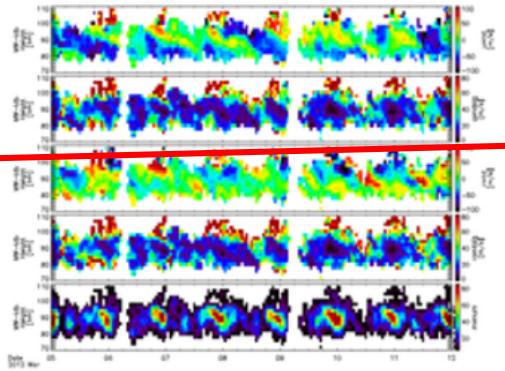
No Data

Numerical Data Wind data in the mesosphere and lower thermosphere estimated from the observation data of the MF radar at Pontianak (NetCDF format)

MW Radar



Numerical Data Horizontal wind data in the equatorial mesosphere and lower thermosphere estimated from the meteor radar observations at Biak (NetCDF format)



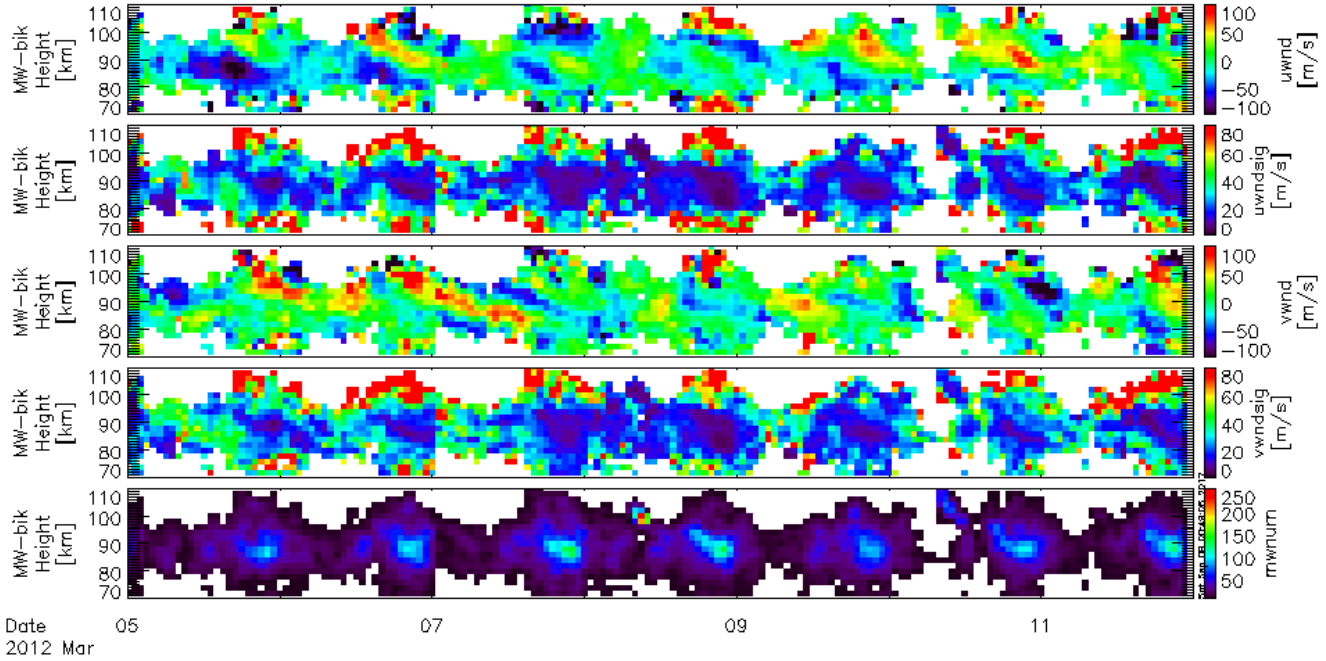
Numerical Data Horizontal wind data in the equatorial mesosphere and lower thermosphere estimated from the meteor radar observations at Kototabang (NetCDF format)

You can find how to load and plot data from meteor radar at Biak by using IUGONET Type-A.

Plot meteor radar data (2)

1. THEMIS> timespan, ['2012-03-05/00:00:00', '2012-03-12/00:00:00']
2. THEMIS> iug_load_meteor_rish, site='bik', parameter=['h2t60min00',
   'h2t60min30', 'h4t60min00', 'h4t60min30'], length='1_day'
   (Load meteor radar data at Biak.)
3. THEMIS> tplot, ['iug_meteor_bik_uwnd_h2t60min00',
   'iug_meteor_bik_uwndsig_h2t60min00', 'iug_meteor_bik_vwnd_h2t60min00',
   'iug_meteor_bik_vwndsig_h2t60min00', 'iug_meteor_bik_mwnum_h2t60min00']

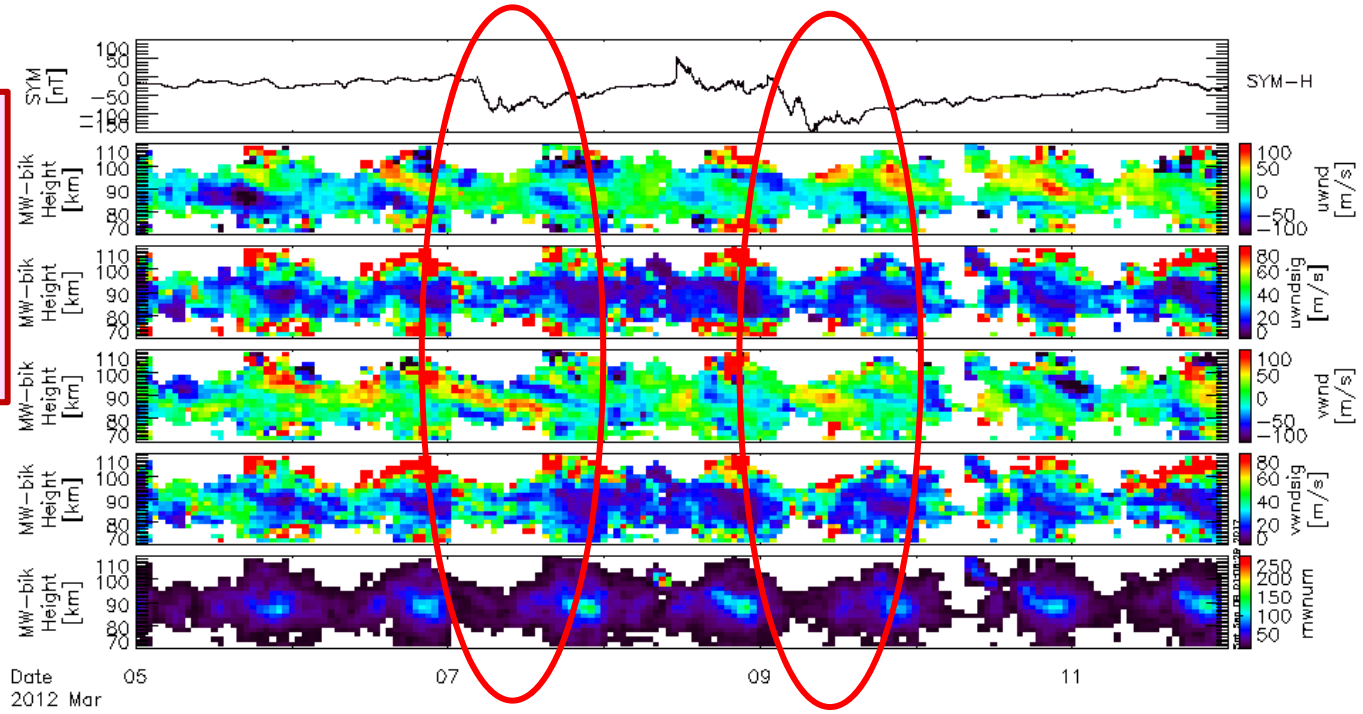
(Plot zonal wind (uwnd), meridional wind (vwnd), and their variance and number of meteor.)



Plot meteor radar data (3)

1. THEMIS> iug_load_gmag_wdc, site='sym'
   (Load SYM index.)
2. THEMIS> split_vec, 'wdc_mag_sym'
   (Split SYM index into each component.)
3. THEMIS> tplot, ['wdc_mag_sym_1', 'iug_meteor_bik_uwnd_h2t60min00',
   'iug_meteor_bik_uwndsig_h2t60min00', 'iug_meteor_bik_vwnd_h2t60min00',
   'iug_meteor_bik_vwndsig_h2t60min00', 'iug_meteor_bik_mwnum_h2t60min00']
   (Plot both SYM index and meteor radar data)

Does the meridional wind change during the geomagnetic storm?



Note

- Even if you can not find some kinds of data at the IUGONET Type-A, it may be possible for you to analyze the data with SPEDAS. Please notice that all IUGONET data have not been registered to IUGONET Type-A.

- QL plots of recent data have not been created yet at IUGONET Type-A, however, it may be possible for you to plot the data with SPEDAS.