IUGONET

Metadata DB for Upper Atmosphere

1st International School on Equatorial Atmosphere 2019
Auditorium LAPAN Bandung – Indonesia
March 18-22, 2019

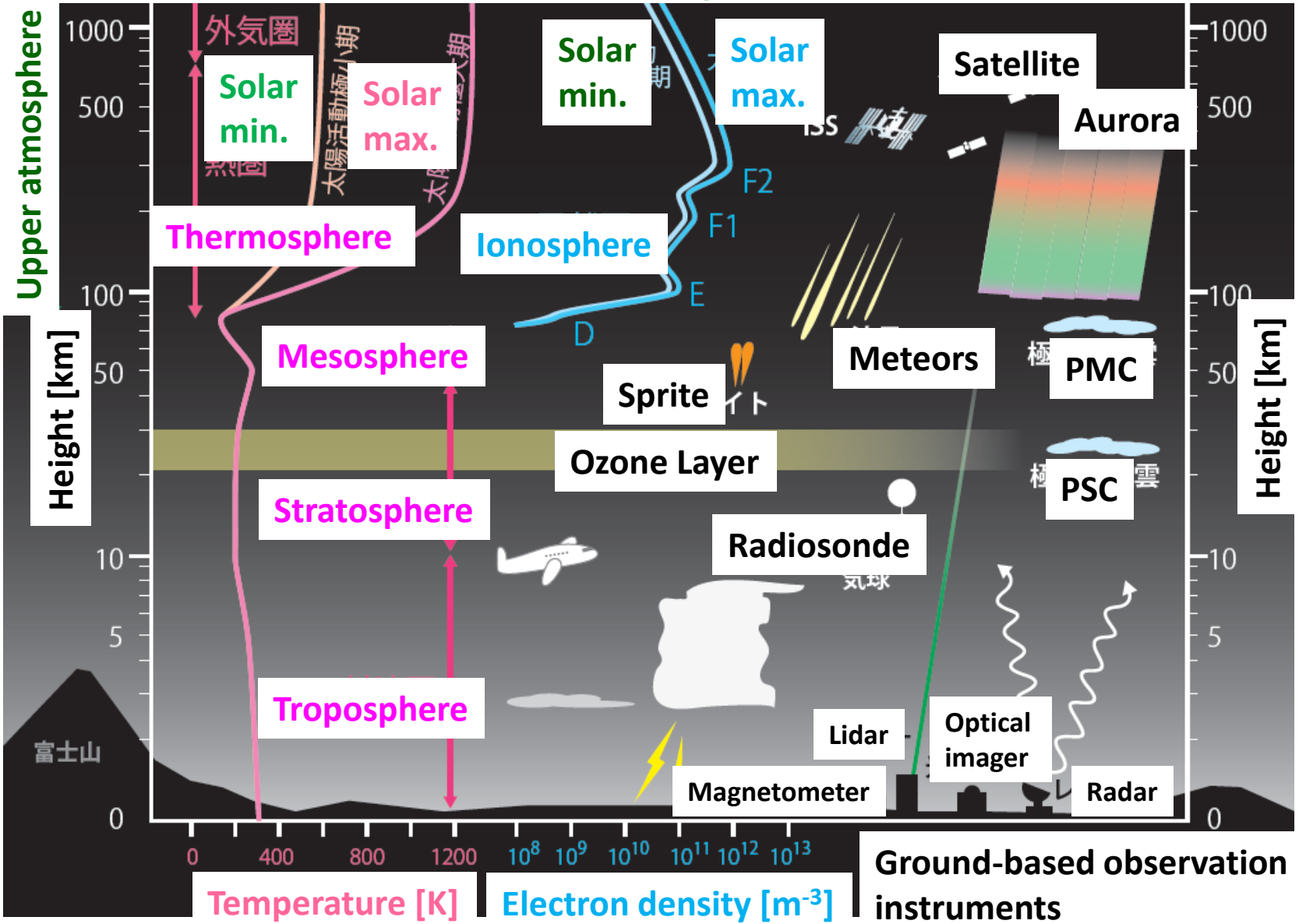
Lessons 7 and 8: IUGONET data analysis for promotion of atmospheric science

Institute for Space-Earth Environmental Research (ISEE),
Nagoya University

0. Contents

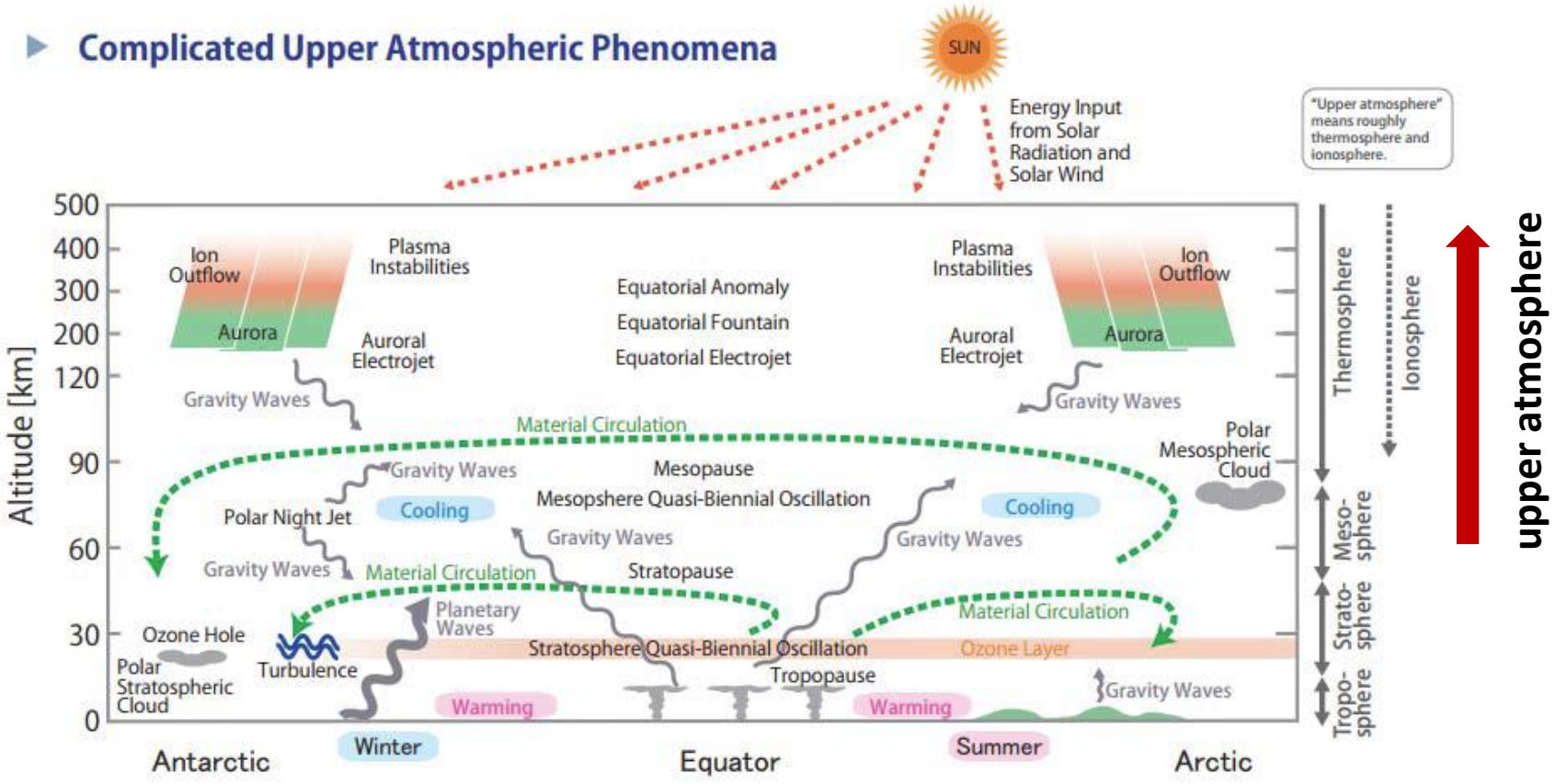
1. Introduction

1.1 Structure of the Earth's atmosphere



1. Introduction

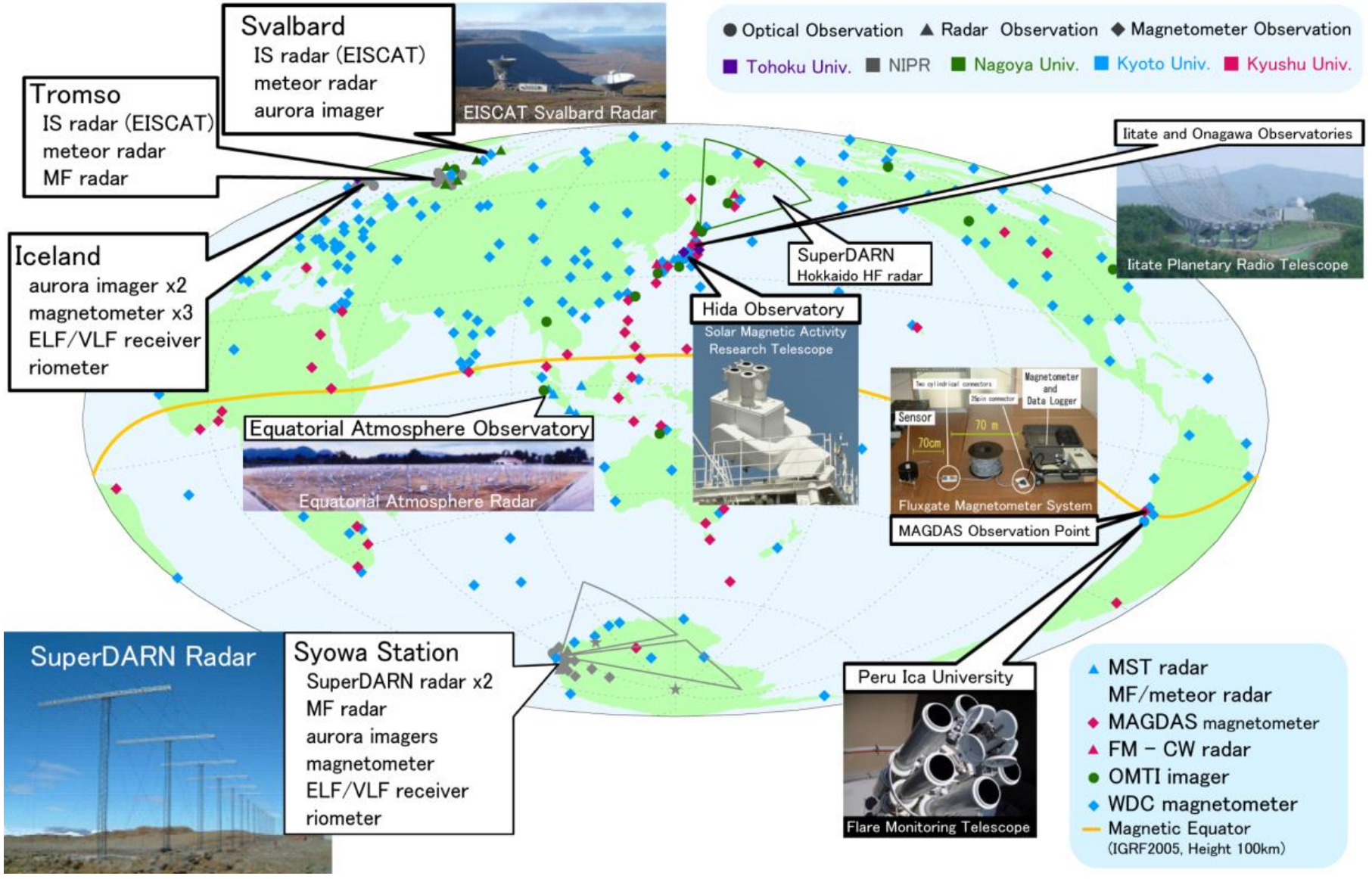
1.2 Coupling process in the solar-terrestrial system



The upper atmosphere are influenced by both solar activity and atmospheric waves propagating upward from the lower atmosphere. To understand the generation mechanism of upper atmospheric variations, we need to perform an integrated analysis with different types of atmospheric observation data.

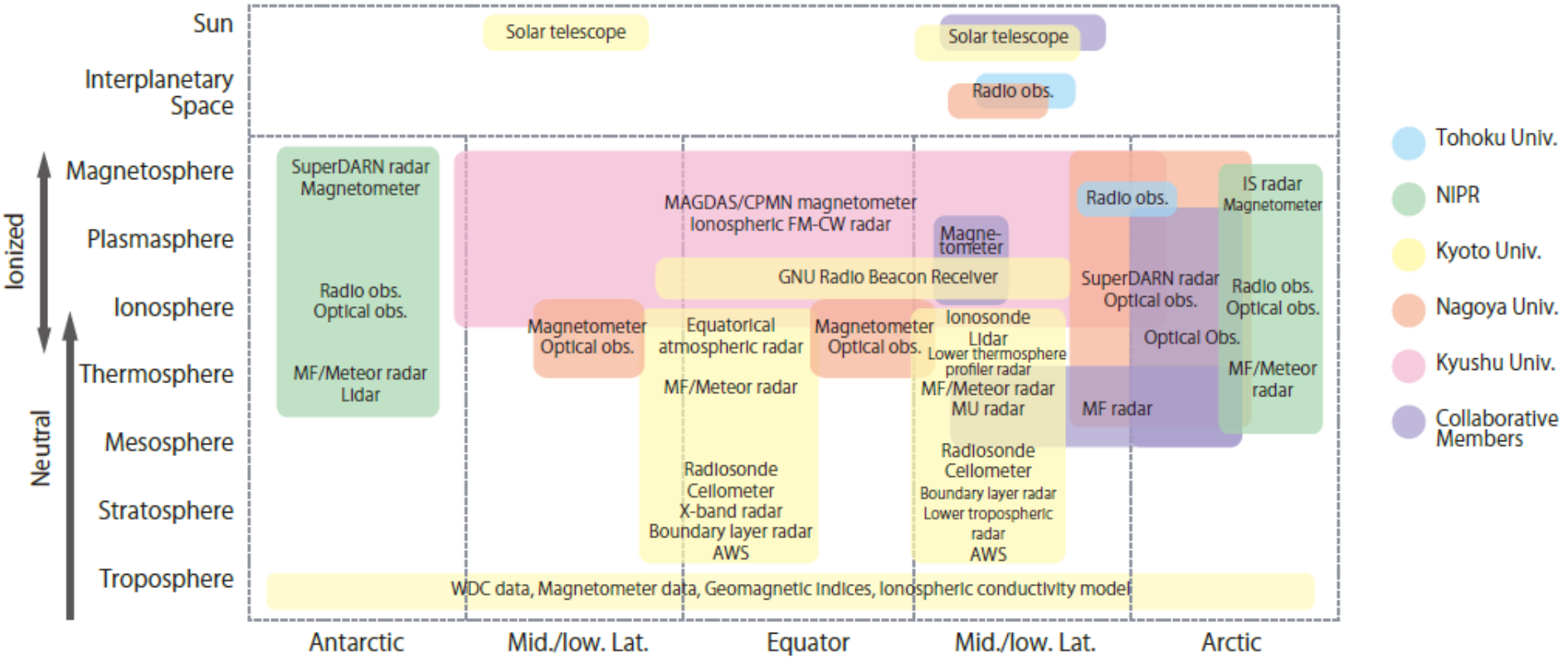
1. Introduction

1.3 Global observation network



1. Introduction

1.4 Coverage of ground-based instruments



Various kinds of ground-based observation data taken by different techniques cover a wide region from both the poles to equator and from the troposphere to solar surface.

1. Introduction

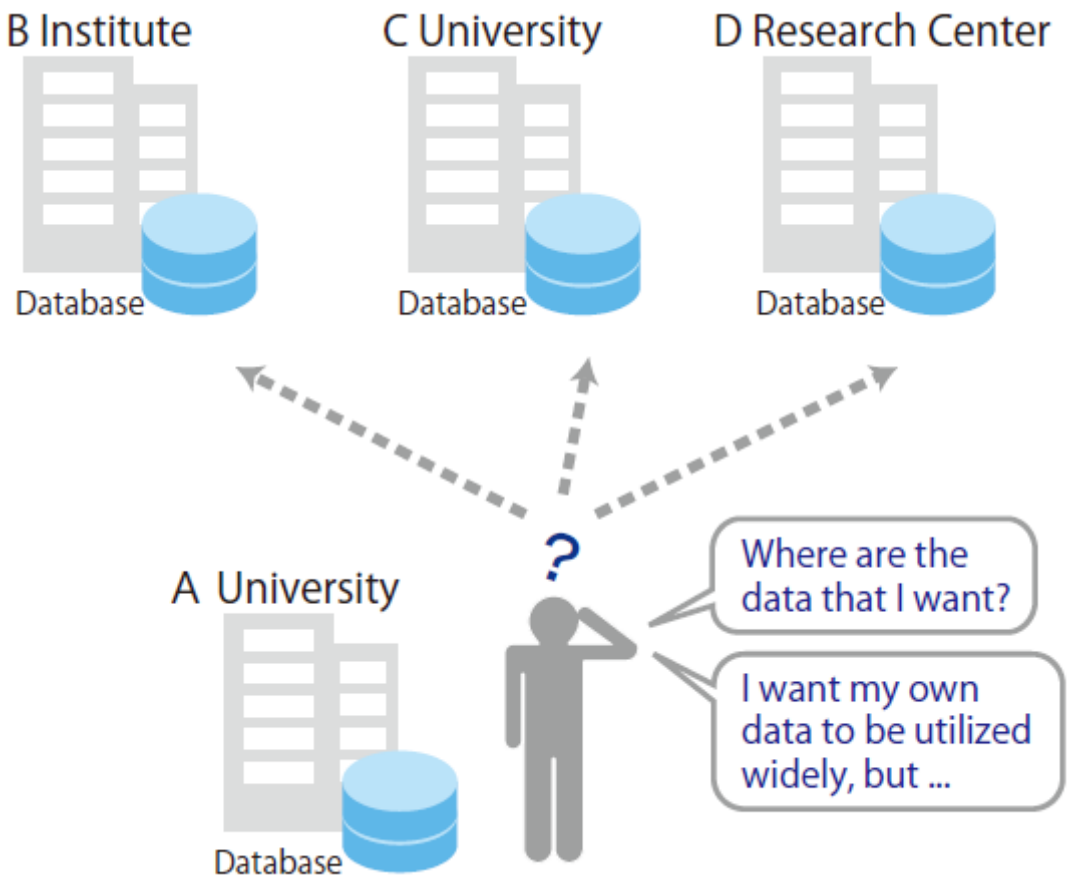
1.5 Major problems of openness of observation data

Each research group has its own observation database.

Most observation data are used only in a particular institute or domain, and some data remain undisclosed.

Much time and troublesome procedures are required for external researchers to access databases of observation data.

Interdisciplinary research requiring various observation data is inhibited.

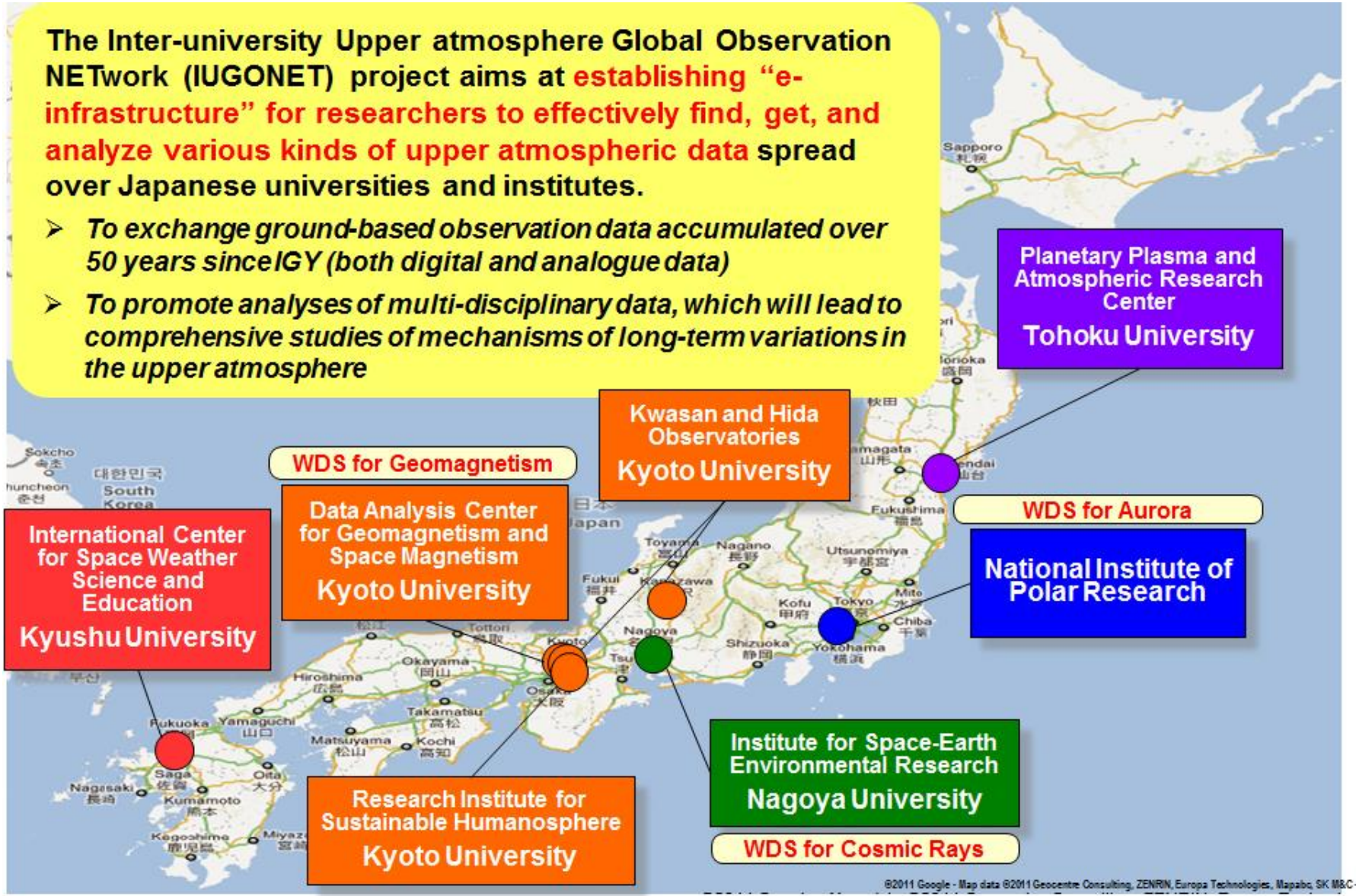


1. Introduction

1.6 The IUGONET project and its objectives

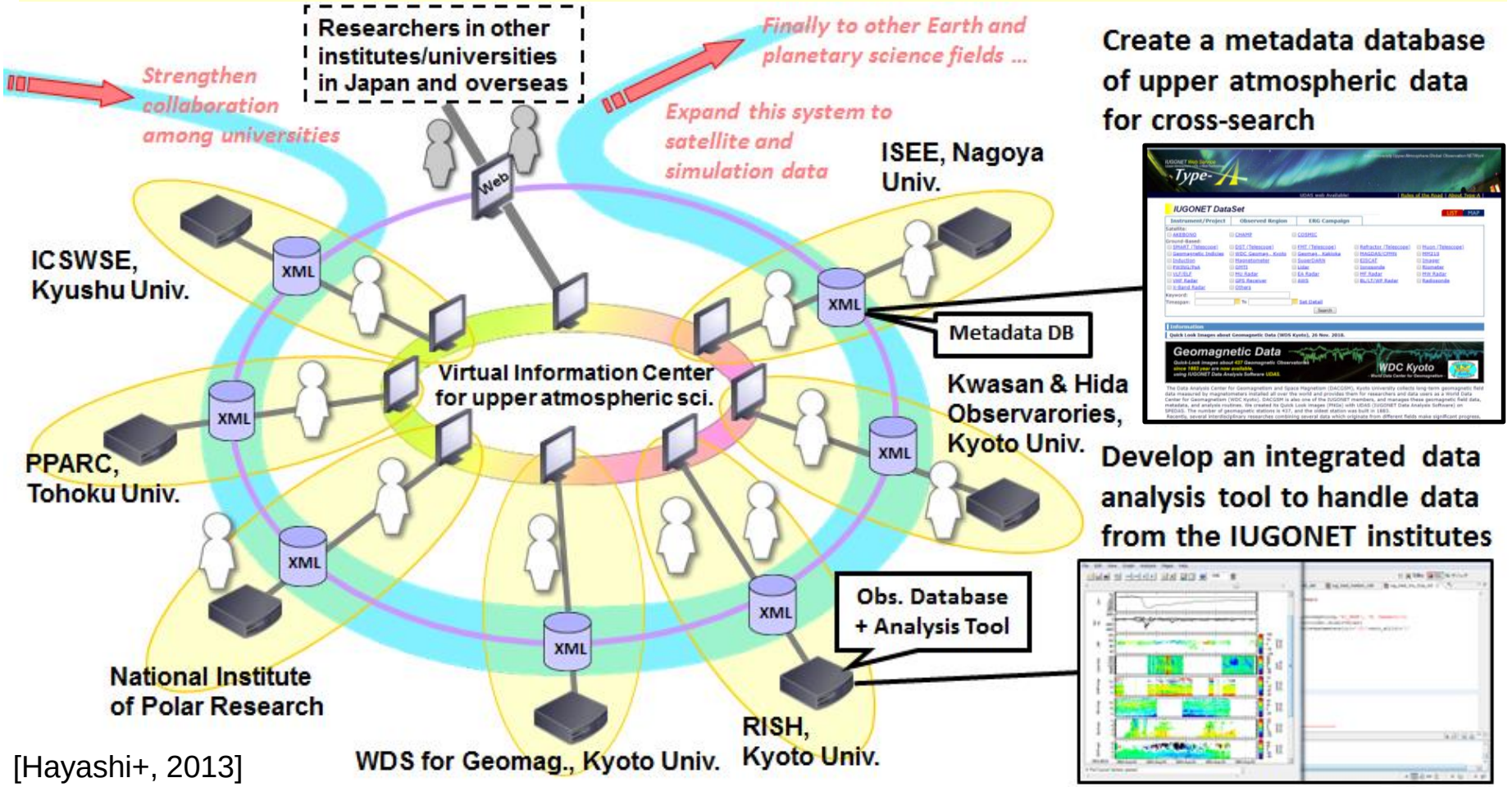
The Inter-university Upper atmosphere Global Observation NETwork (IUGONET) project aims at establishing "e-infrastructure" for researchers to effectively find, get, and analyze various kinds of upper atmospheric data spread over Japanese universities and institutes.

- ***To exchange ground-based observation data accumulated over 50 years since IGY (both digital and analogue data)***
- ***To promote analyses of multi-disciplinary data, which will lead to comprehensive studies of mechanisms of long-term variations in the upper atmosphere***



1.7 An overview of the IUGONET project

In order to promote an interdisciplinary study of coupling processes in solar-terrestrial system, we need to establish a database of data information (metadata) on ground-based observation data for cross-search and to develop an integrated data analysis tool.



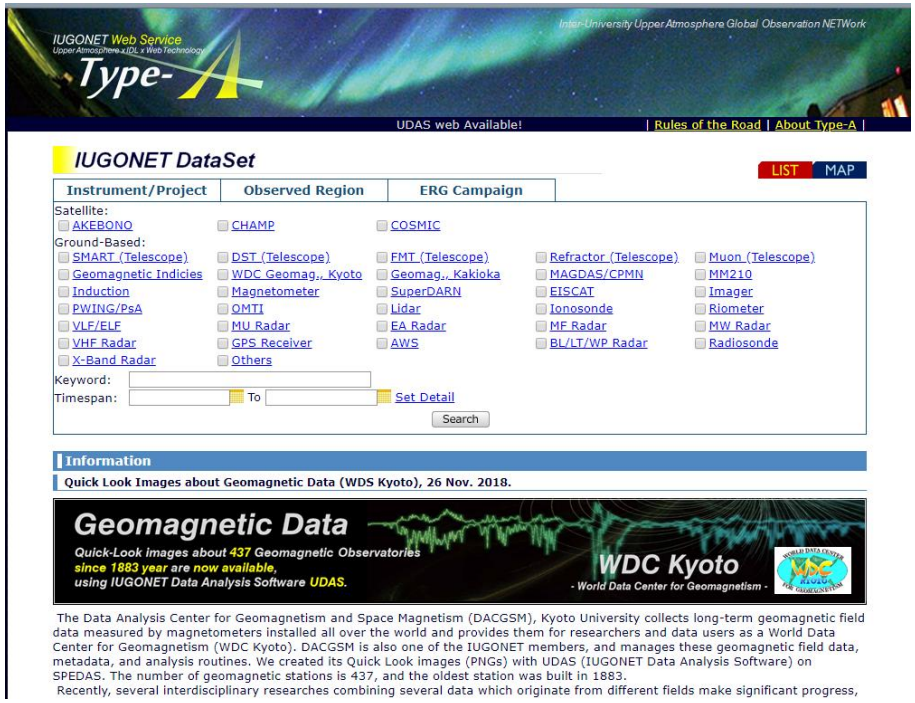
[Hayashi+, 2013]

1. Introduction

1.8 IUGONET products (IUGONET Type-A and UDAS)

IUGONET web-service

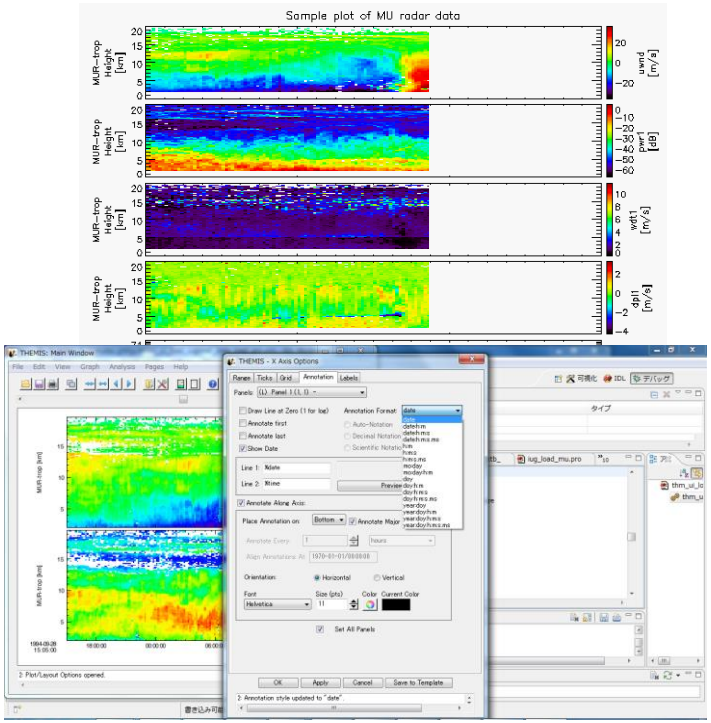
To cross-search various kinds of ground-based solar and earth's atmospheric observation data.



http://search.iugonet.org

iUgonet Data Analysis Software (UDAS)

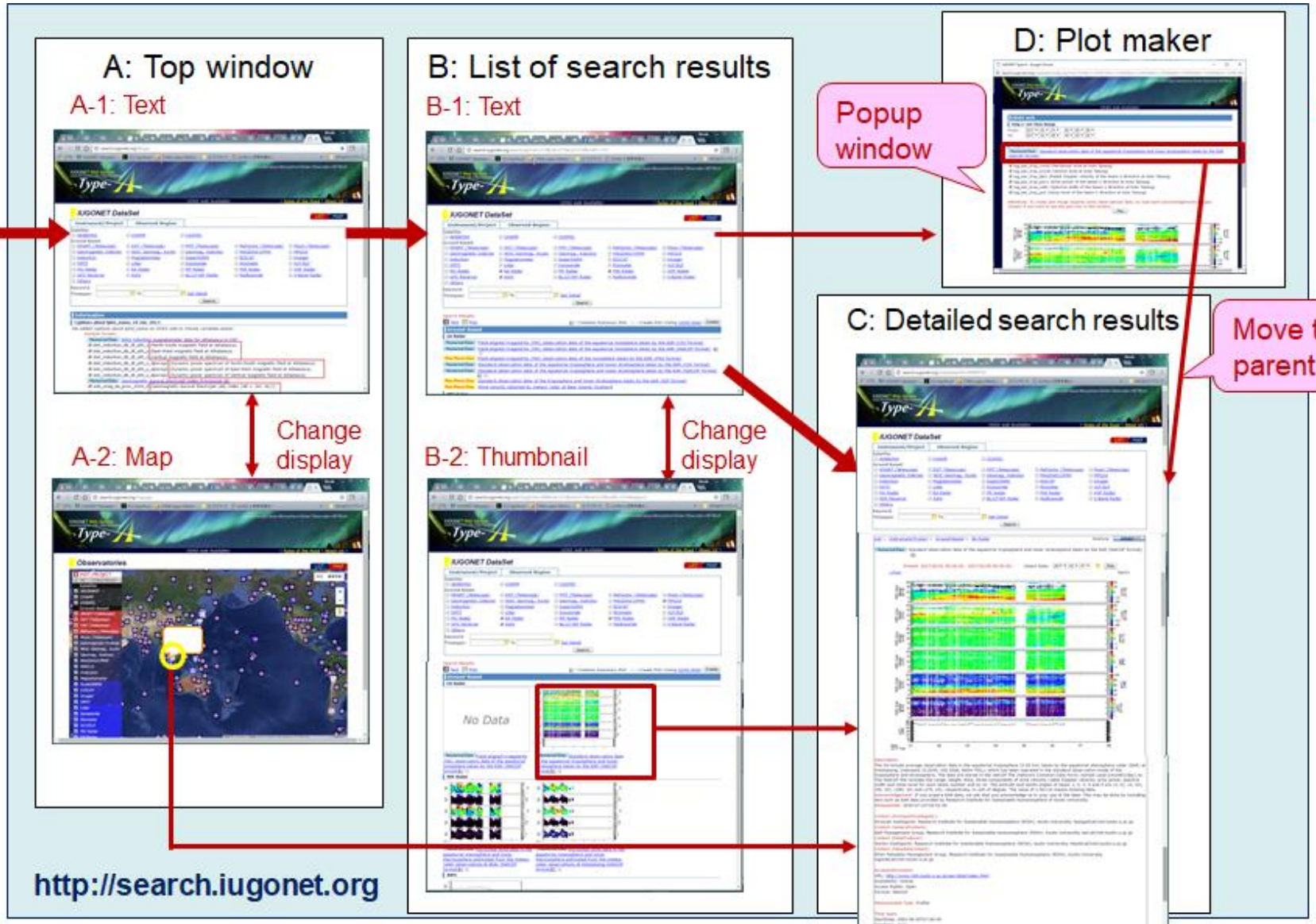
Integrated data analysis tool to handle various kinds of observation data provided by the IUGONET institutes.



http://www.iugonet.org/product/analysis.jsp

1. Introduction

1.9 Structure of IUGONET Type-A



1.10 What can you learn from IUGONET Type-A?

- **Basic information of observation data you want to know**

  Observation site, method (instrument), period, observed region, data format, data policy, person

  → **These become basic material when you write scientific paper.**

- **Quick look (QL) plot of observation data related to category and keywords**

  → **The Q plots displayed in IUGONET Type-A has a common time interval of 1, 3, and 7 days for the data you can plot with SPEDAS.**

  Because their time axes are the same, you can easily compare different types of observation data (ex. neutral wind, solar wind, geomagnetic field) and may find new relationship between the phenomena observed in the different atmospheric layers.

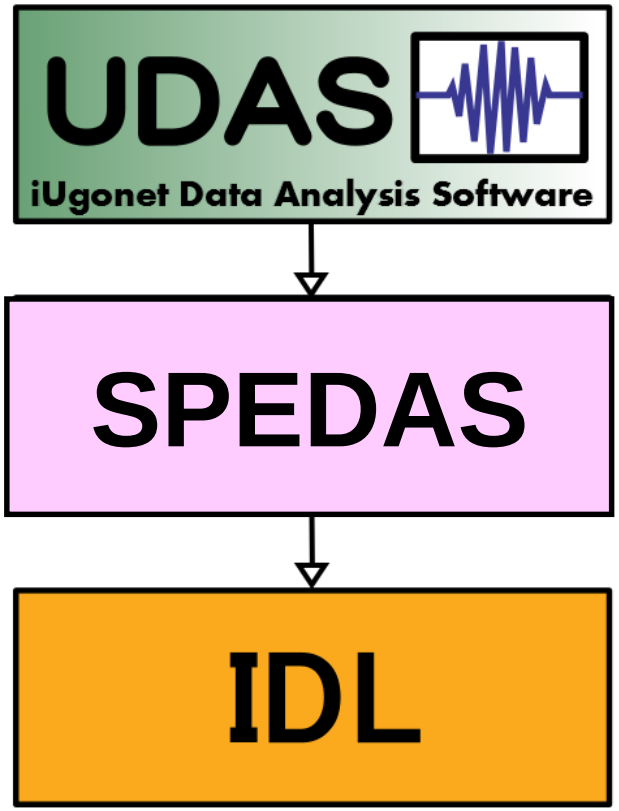
- **How to create time-series plots of observation data with SPEDAS**

  → **You can easily make several line or contour plots of solar and atmospheric data at anytime and anywhere by yourself.**

1. Introduction

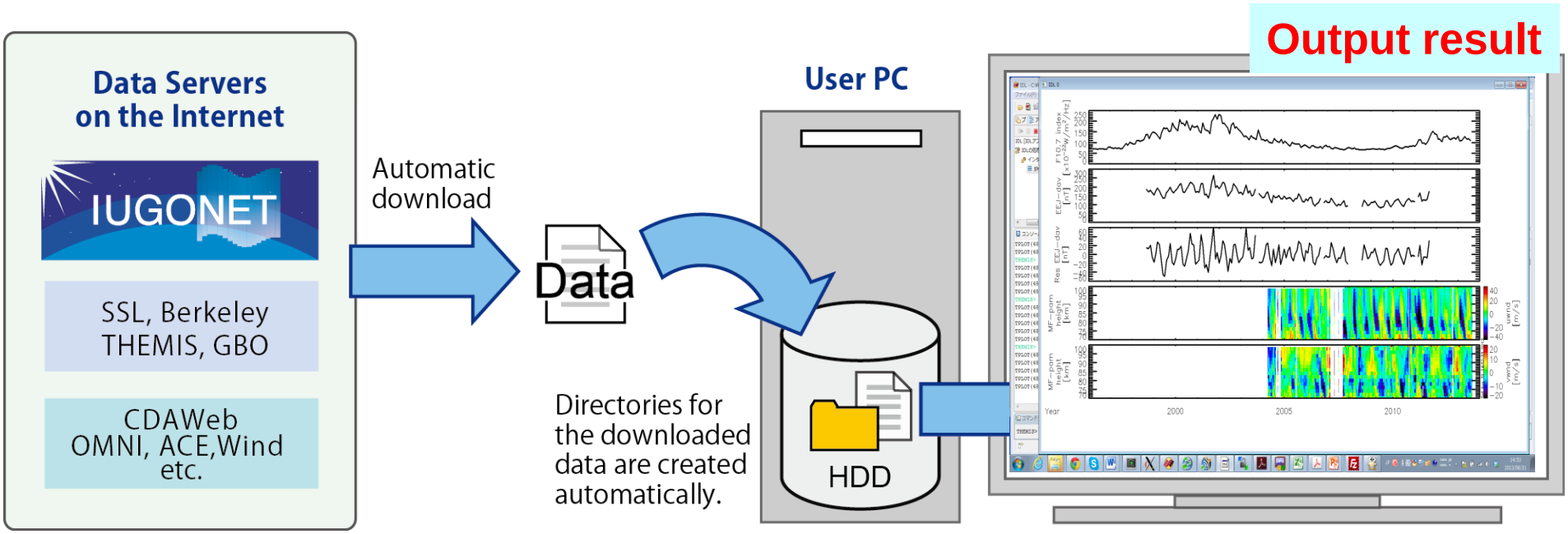
1.11 Analysis software: SPEDAS

- **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**



1. Introduction

1.12 Characteristics of 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, +++

In case of the GUI tool, only a few simple clicks of your mouse are required to procedure the same plot as that created by the above command with the CUI tool.

1. Introduction

1.13 Datasets to handle with SPEDAS

SPEDAS

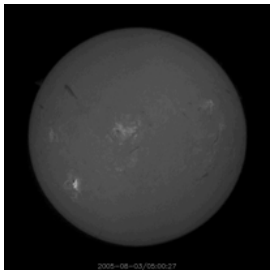
Satellite

ACE, DISCOVER, WIND
--- Interplanetary
ERG, FAST, GOES, MMS, RBSP, THEMIS
--- Magnetosphere
ICON, POES --- Ionosphere
COSMIC, CHAMP --- Atmosphere
MAVEN --- Mars

Ground/Model

ERG, IUGONET
--- Solar telescope, Radar, Imager, Ionosonde, Magnetometer, AWS, Riometer, SuperDARN, GPS, Kyushu GCM

Sun



Space

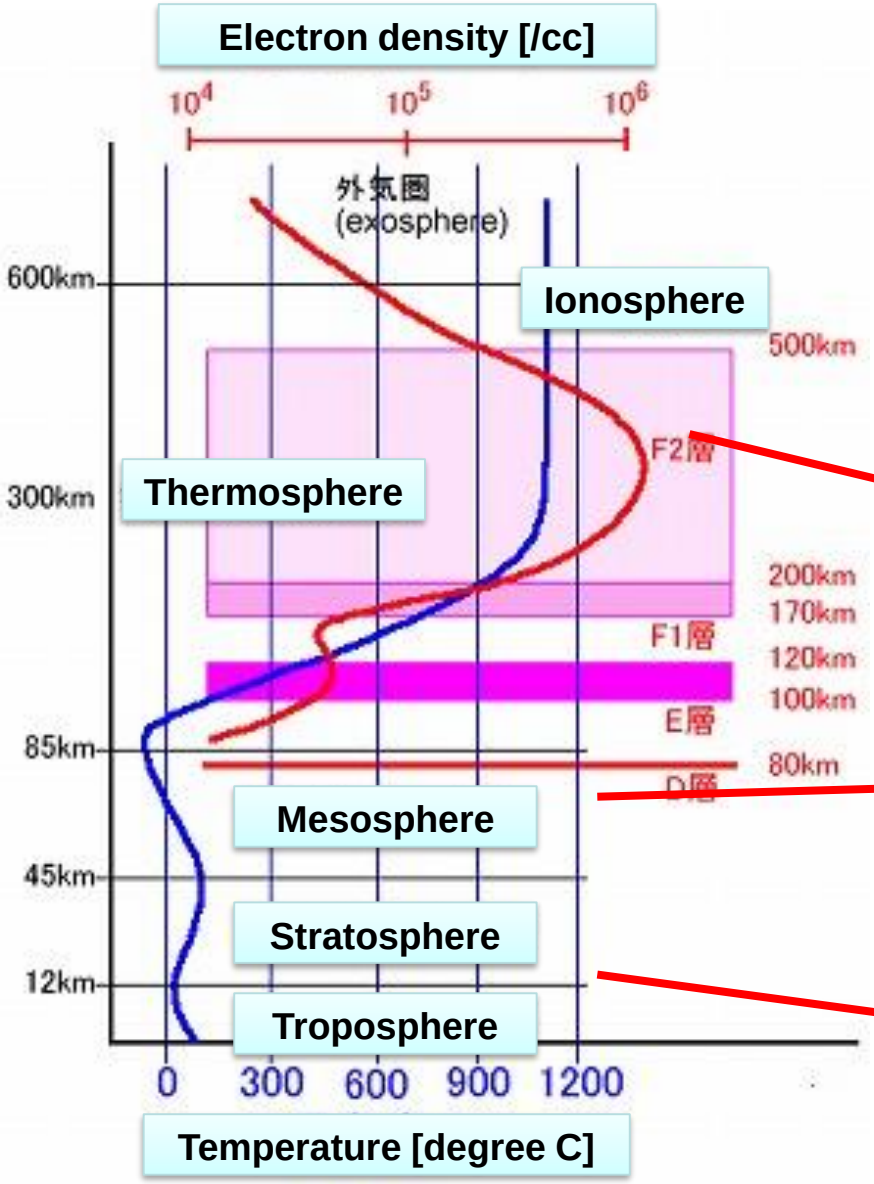
Integrated data analysis

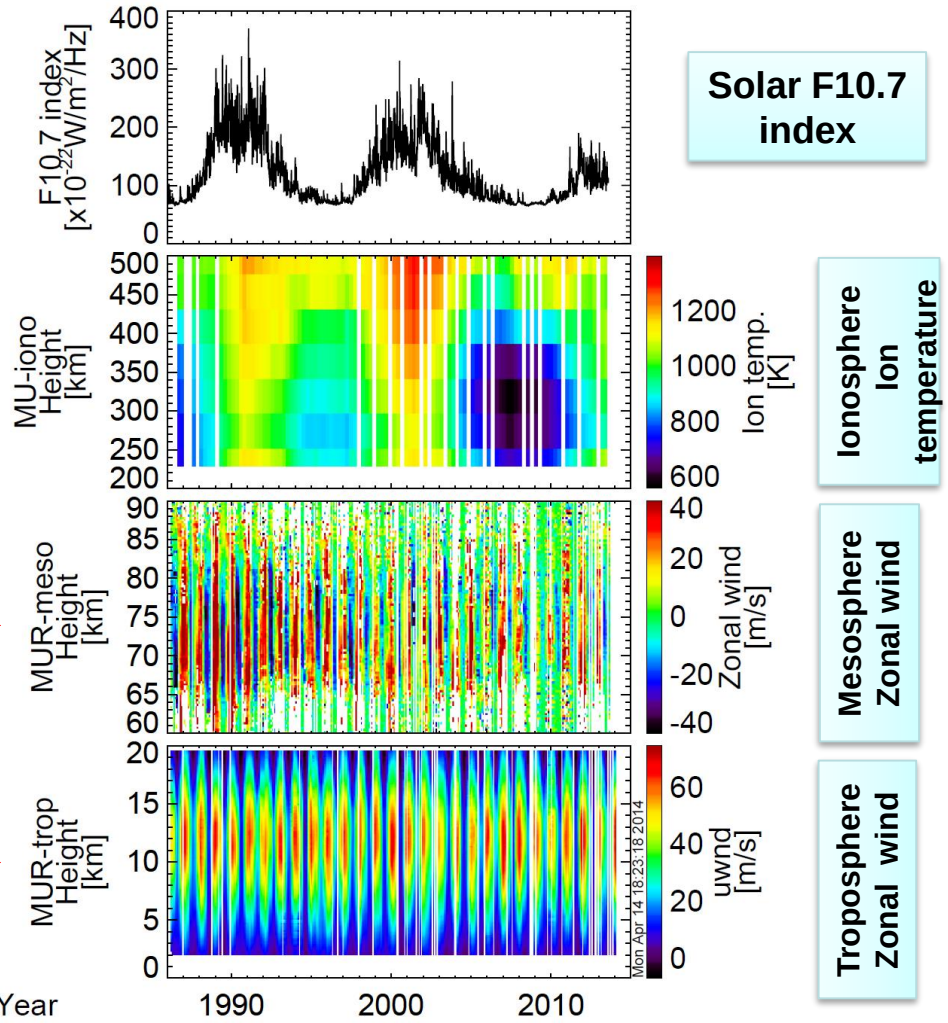
Earth's atmosphere

IUGONET observatories

1. Introduction

1.14 Example of data plot with SPEDAS





1. Introduction

1.15 Executable file of SPEDAS-GUI

We built the SPEDAS executive file working on IDL Virtual Machine.

You can use the SPEDAS (with only GUI) without any IDL licenses. You can get the executable file from the SPEDAS website.

If you don't have an IDL license

SPEDAS is free software but if you do not have an IDL license, then you cannot use the IDL command line, and hen
options:

1. Download the SPEDAS executable (for Linux, MacOS, or Windows), or
2. Download the SPEDAS save file (for Solaris or other operating systems).

Download the SPEDAS executables, Version 3.1.1 (October 2018, minor refre

Note: In January 2019, we created new executable files (spedas version 3.1.1). However, the only change is the cor

For users without IDL licenses, you can use the SPEDAS 3.1.1 executable files for Linux, Windows, and MacOS, whic
required.

* SPEDAS 3.1.1, Windows 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~55 MB)
* SPEDAS 3.1.1, MacOs 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~70 MB)
* SPEDAS 3.1.1, Linux 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~70 MB)
* SPEDAS 3.1.1, Linux 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 7.6 (~70 MB) - includes Geopack 7.6

This release contains everything you need, including the IDL VM, the Geopack DLM and the CDF DLM. You just have

Download the SPEDAS save file, Version 3.1.1 (October 2018, minor refresh J

Note: In January 2019, we created a new save file (spedas version 3.1.1). However, the only change is the correctio

The SPEDAS save file requires the run-time IDL Virtual Machine (VM) which has to be downloaded for free from H

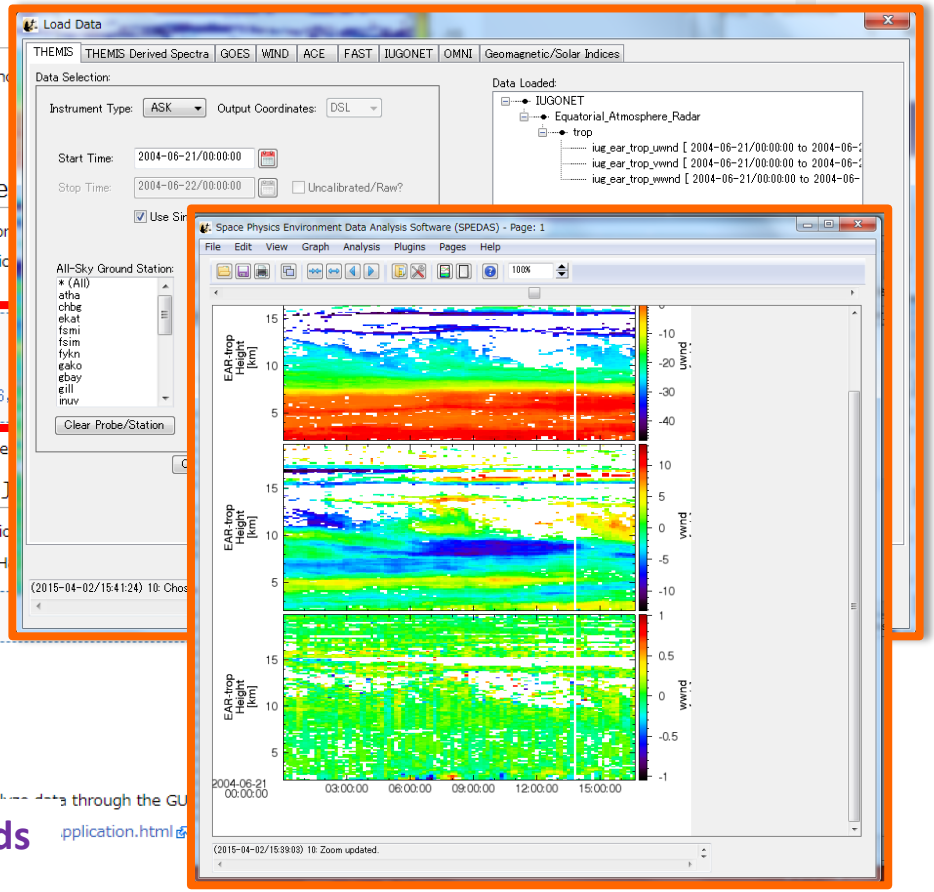
* SPEDAS 3.1.1, IDL Savefile (20 MB)

To run SPEDAS using the IDL virtual machine,

1. start the IDL virtual machine executable
2. click through the splash screen to get to the file selection dialog
3. navigate to the SPEDAS installation
4. go into the thm_gui_new directory and click on thm_gui.sav

through the GU

pplication.html



http://spedas.org/wiki/index.php?title=Downloads_and_Installation

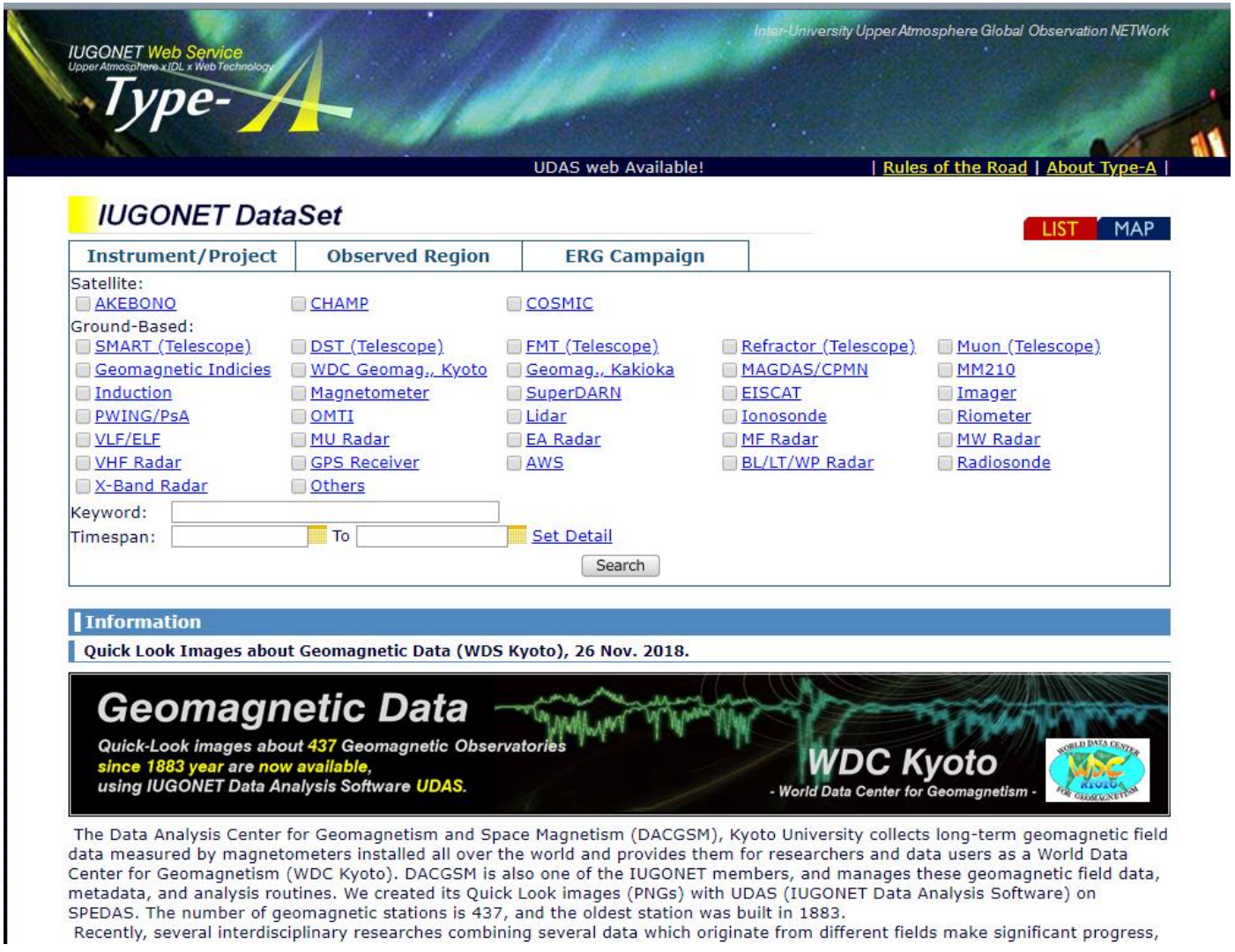
Section 2

How to use a database of data information for solar and atmospheric data (IUGONET Type-A)

2. How to use IUGONET Type-A

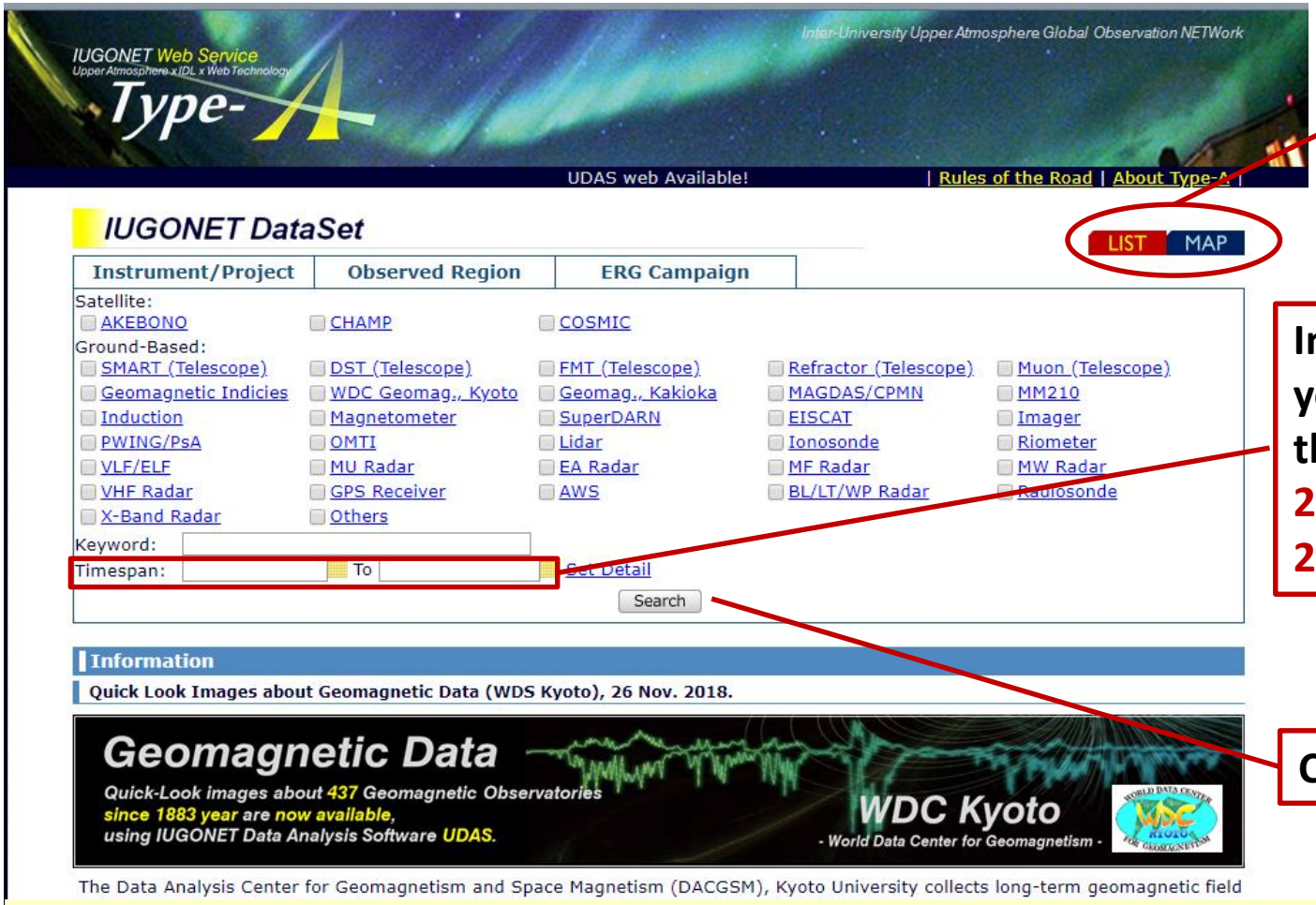
2.1 Access to IUGONET Type-A (http://search.iugonet.org)

Please access IUGONET Type-A from Internet browser with your own PC.



2. How to use IUGONET Type-A

2.2 Search data on the top window (list search)



Exchange the list search into map search

Input a timespan you want to search the data
2012/03/04 (from)
2012/03/10 (to)

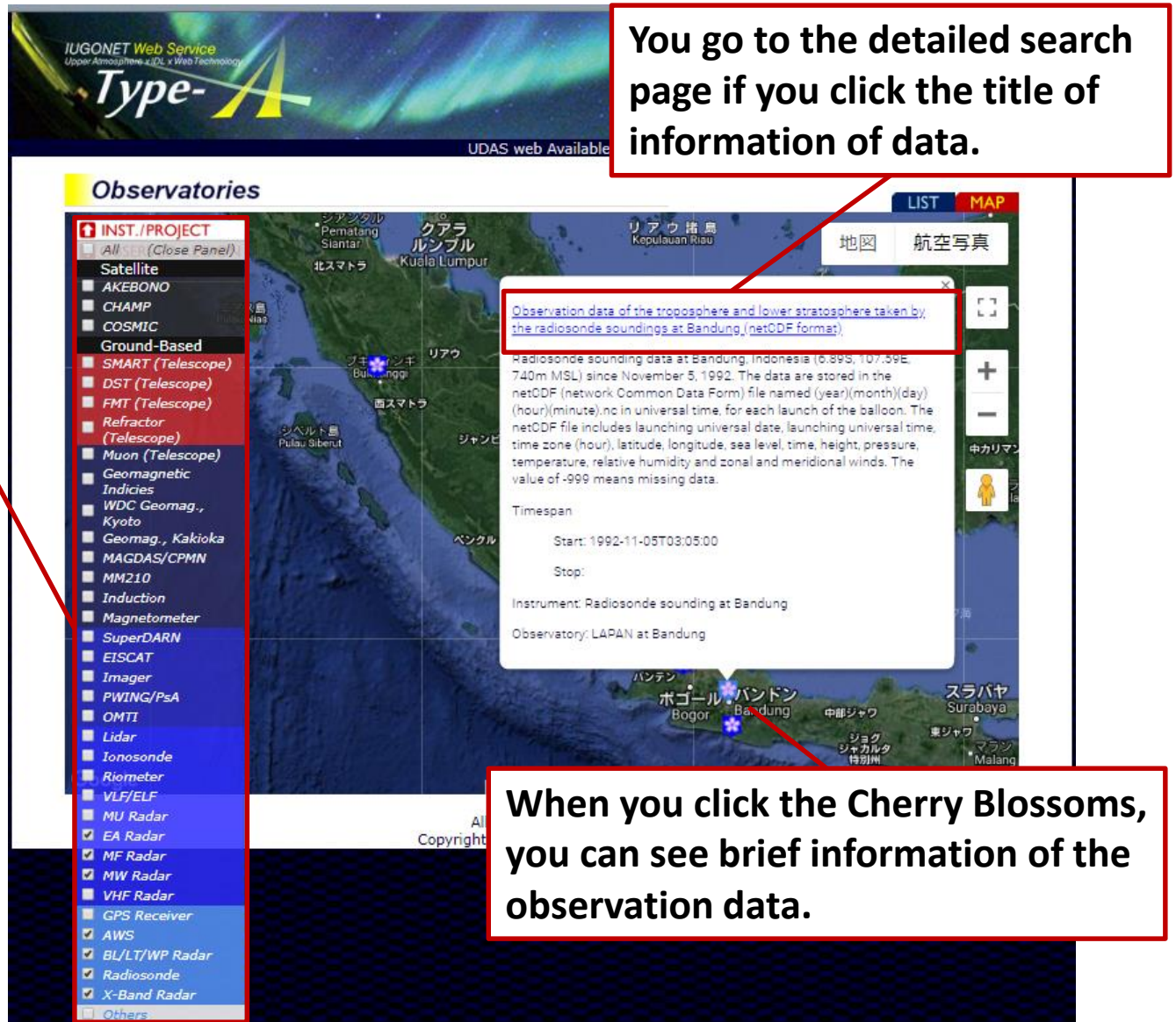
Click “search” button

You can restrict the search results by selecting the related instrument/project or inputting the keyword related to the data you want to know.

2. How to use IUGONET Type-A

2.2 Search data on the top window (map search)

The default is selected all the instruments.
If you specify them, you exclude the check "All" and include the check for each instrument you want to know.



You go to the detailed search page if you click the title of information of data.

When you click the Cherry Blossoms, you can see brief information of the observation data.

2. How to use IUGONET Type-A

2.3 Search results (text)

IUGONET DataSet

LIST MAP

Instrument/Project | Observed Region | ERG Campaign

Satellite:
AKEBONO, CHAMP, COSMIC

Ground-Based:
SMART (Telescope), DST (Telescope), FMT (Telescope), Refractor (Telescope), Muon (Telescope)
Geomagnetic Indicies, WDC Geomag., Kyoto, Geomag., Kakioka, MAGDAS/CPMN, MM210
Induction, Magnetometer, SuperDARN, EISCAT, Imager
PWING/PsA, OMTI, Lidar, Ionosonde, Riometer
VLF/ELF, MU Radar, EA Radar, MF Radar, MW Radar
VHF Radar, GPS Receiver, AWS, BL/LT/WP Radar, Radiosonde
X-Band Radar, Others

Keyword:
Timespan: 2012/03/04 To 2012/03/10 Set Detail
Search

Search Results:
Text Plot
: Contains Summary Plot : Create Plot (Using UDAS-Web) Create

Satellite

AKEBONO

Numerical Data	Observation data from VLF/MCA onboard Akebono

COSMIC

Numerical Data	COSMIC full spectrum inversion (FSI) data (netCDF)
Plot/Movie Data	COSMIC full spectrum inversion (FSI) data (PNG)
Plot/Movie Data	Global distribution of dry air temperature at 15 km derived from the COSMIC full spectrum inversion (FSI) data (PNG)
Plot/Movie Data	Global distribution of dry air temperature variance in a height range of 10 - 30 km derived from the COSMIC full spectrum inversion (FSI) data (PNG)

Ground-Based

SMART (Telescope)

Plot/Movie Data	Quick-look images of SMART/T3 H-alpha and continuum partial-region solar images
Numerical Data	SMART/T1 H-alpha full-disk solar images
Plot/Movie Data	SMART/T1 H-alpha full-disk solar images in JPEG format
Numerical Data	SMART/T3 H-alpha and continuum partial-region solar images
Plot/Movie Data	SMART H-alpha movies of representative solar prominence eruptions and flares

DST (Telescope)

Numerical Data	DST/H-alpha multi-wavelength partial solar images with the KODAK CCD
Plot/Movie Data	DST/H-alpha partial solar quick-look images
Numerical Data	DST solar spectrum data with spectrographs
Plot/Movie Data	DST Spectroheliograph quick-look images

You can exchange text into QL plot displays.
If you click "Plot", you can find the QL plots of each dataset.

List of the search results you want to know.
If you click the title of each dataset, you go to the detailed search page.

2. How to use IUGONET Type-A

2.4 Search results (plot)

IUGONET DataSet

LIST MAP

Instrument/Project	Observed Region	ERG Campaign

Satellite:
AKEBONO CHAMP COSMIC

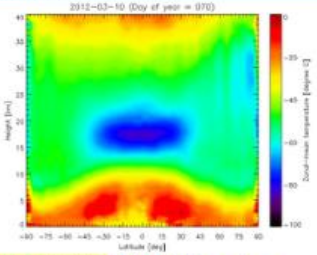
Ground-Based:

SMART (Telescope)	DST (Telescope)	FMT (Telescope)	Refractor (Telescope)	Muon (Telescope)
Geomagnetic Indicies	WDC Geomag., Kyoto	Geomag., Kakioka	MAGDAS/CPMN	MM210
Induction	Magnetometer	SuperDARN	EISCAT	Imager
PWING/PsA	OMTI	Lidar	Ionosonde	Riometer
VLF/ELF	MU Radar	EA Radar	MF Radar	MW Radar
VHF Radar	GPS Receiver	AWS	BL/LT/WP Radar	Radiosonde
X-Band Radar	Others			

Keyword:
Timespan: 2012/03/04 To 2012/03/10 Set Detail
Search

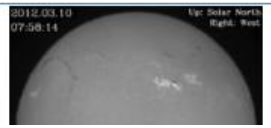
Search Results: : Contains Summary Plot : Create Plot (Using UDAS-Web) Create
Text Plot <Prev Numerical: 2012/03/04 00:00:00 - 2012/03/11 00:00:00, Plot/Movie: 2012/03/10 Timespan: 1 3 7 Next>

Satellite
COSMIC



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

Ground-Based
SMART (Telescope)



Temperature profile obtained from the COSMIC RO data.

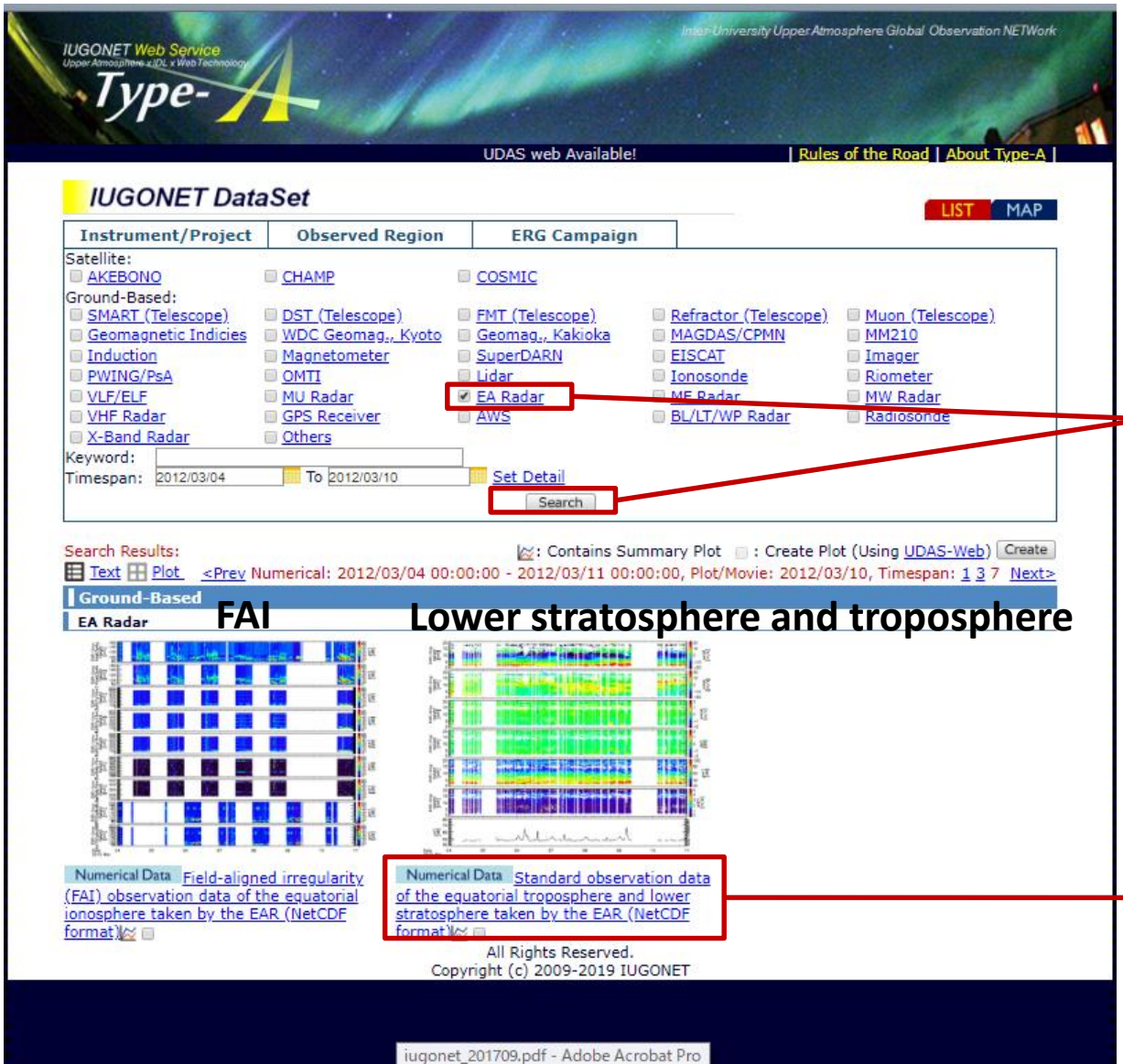
Solar surface image obtained from the solar terescope.

You can select three kinds of time range (1, 3, and 7 days).
The default is 7 days.

The start time of the QL plots corresponds to that of timespan you specify.

2. How to use IUGONET Type-A

2.4 Search results (plot) (specify EAR)

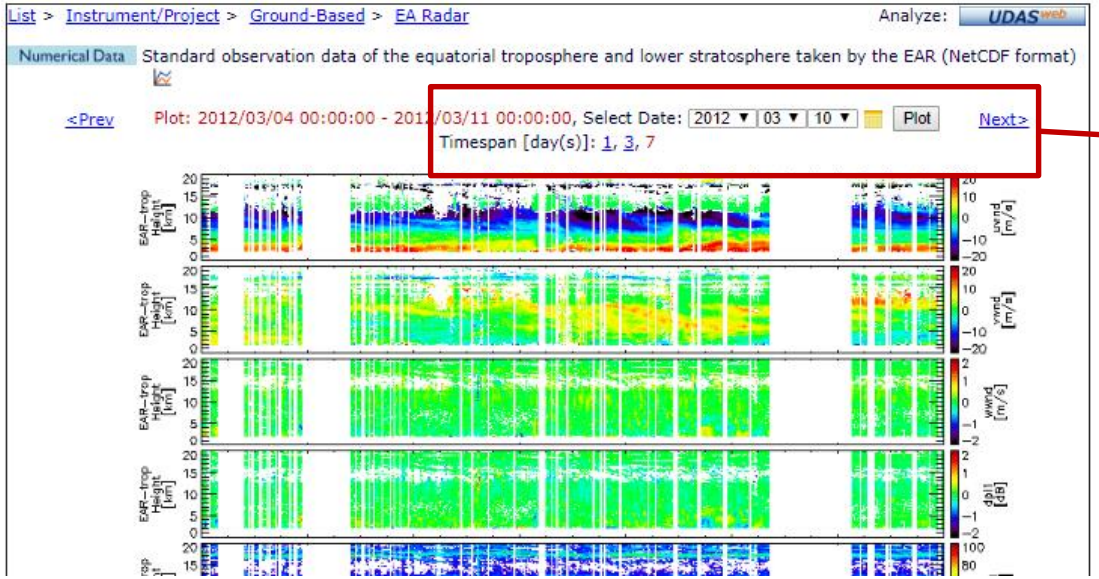


If you click the check box of "EA Radar" and click "search" button, the QL plots of FAI and lower stratosphere and troposphere data taken by EAR appear as shown in the left figure.

If you click the title of dataset, you go to the detailed search result.

2. How to use IUGONET Type-A

2.5 Detailed search results



From the detailed search results, you can know valuable information of the data you want to know.

You can change the start time of QL plot and time intervals (1, 3, or 7 days).

Scroll down

2. How to use IUGONET Type-A

2.5 Detailed search results

Description:
The 10-minute average observation data in the equatorial troposphere (2-20 km) taken by the equatorial atmosphere radar (EAR) at Kototabang, Indonesia (0.203S, 100.320E, 865m MSL), which has been operated in the standard observation mode of the troposphere and stratosphere. The data are stored in the netCDF file (Network Common Data Form) named (year)(month)(day).nc. The NetCDF file includes the range, height, time, three components of wind velocity, radial Doppler velocity, echo power, spectral width and noise level for each beam number and so on. The azimuth and zenith angles of beam 1, 2, 3, 4 and 5 are (0, 0), (0, 10), (90, 10), (180, 10) and (270, 10), respectively, in unit of degree. The value of 1.0e+10 means missing data.
Acknowledgement: If you acquire EAR data, we ask that you acknowledge us in your use of the data. This may be done by including text such as EAR data provided by Research Institute for Sustainable Humanosphere of Kyoto University.
ReleaseDate: 2016-07-21T16:51:00

Contact (PrincipalInvestigator):
Hiroyuki Hashiguchi, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, hasiguti(at)rish.kyoto-u.ac.jp
Contact (GeneralContact):
EAR Management Group, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, ear(at)rish.kyoto-u.ac.jp
Contact (DataProducer):
Noriko Hashiguchi, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, nhashi(at)rish.kyoto-u.ac.jp
Contact (MetadataContact):
RISH Metadata Management Group, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, iugonet(at)rish.kyoto-u.ac.jp

AccessInformation:
URL: http://www.rish.kyoto-u.ac.jp/ear/data/index.html
Availability: Online
Access Rights: Open
Format: NetCDF

Measurement Type: Profile

Time Span:
StartDate: 2001-06-20T17:00:00
StopDate: -P1D

Observed Region: Earth.NearSurface.Atmosphere
Observed Region: Earth.NearSurface.Troposphere
Observed Region: Earth.NearSurface.Stratosphere
Observed Region: Earth.NearSurface.EquatorialRegion

Keywords: EARTH SCIENCE Atmosphere Atmospheric Winds Wind Profiles

Instrument:
Name: Equatorial Atmosphere Radar (EAR)
Description: Equatorial Atmosphere Radar (EAR) is a large Doppler radar built for atmospheric observation at the equator in West Sumatra, Indonesia (0.20S, 100.32E, 865m MSL). The construction was completed in March 2001, with collaboration between RISH, Kyoto University and the National Institute of Aeronautics and Space of Indonesia (LAPAN) of Indonesia. The EAR has a circular antenna array of approximately 110 m in diameter, which consists of 560 three-element Yagis. It is an active phased array system with each Yagi driven by a solid-state transceiver module. This system configuration makes it possible to direct the antenna beam by electronic control up to 5000 times per second. The EAR transmits an intense radio wave of 47 MHz to the sky and receives extremely weak echoes scattered back by atmospheric turbulence. It can observe winds and turbulence in the altitude range from 2 km to 20 km (troposphere and lower stratosphere). It can also observe echoes from ionospheric irregularities at heights more than 80 km.
Contact (PrincipalInvestigator):
Hiroyuki Hashiguchi, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, hasiguti(at)rish.kyoto-u.ac.jp
Contact (GeneralContact):
EAR Management Group, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, ear(at)rish.kyoto-u.ac.jp
Contact (MetadataContact):
RISH Metadata Management Group, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, iugonet(at)rish.kyoto-u.ac.jp

Data location and format
You can direct access the webpage of observation data

Data description
This information is very helpful for writing scientific papers.

Data use policy

Contact person
From this information, you can easily contact the data PIs.

Information of instrument
This description is also very helpful for writing scientific papers.

Scroll down

2. How to use IUGONET Type-A

2.5 Detailed search results

Observatory:
Name: Equatorial Atmosphere observatory at Kototabang
Description: The Equatorial Atmosphere observatory at Kototabang is located at the equator in West Sumatra, Indonesia (0.20S, 100.32E, 865m MSL). In this site, various kinds of instruments (for example, boundary layer radar (BLR), equatorial atmosphere radar (EAR) and meteor wind (MW) radar) have been installed, which measure the equatorial atmosphere including the troposphere, lower stratosphere, upper mesosphere, thermosphere and ionosphere.
Contact (MetadataContact):
RISH Metadata Management Group, Research Institute for Sustainable Humanosphere (RISH), Kyoto University, iugonet(at)rish.kyoto-u.ac.jp
Location:
ObservatoryRegion: Earth.Surface
CoordinateSystemName: WGS84
Latitude: -0.204
Longitude: 100.320

Observed Data:

How to Plot (SPEDAS-CUI #Basic):
```
IDL>      thm_init
THEMIS> timespan, ['2012-03-04 00:00:00', '2012-03-11 00:00:00']
THEMIS> iug_load_ear, datatype = 'troposphere'
THEMIS> tplot, ['iug_ear_trop_uwnd', 'iug_ear_trop_vwnd', 'iug_ear_trop_wwnd', 'iug_ear_trop_dpl1', 'iug_ear_trop_pwr1',
          'iug_ear_trop_wdt1', 'iug_ear_trop_pn1']
```

How to Plot (SPEDAS-CUI #Advanced [*Quick-Look was created with this command]):
```
IDL>      thm_init
THEMIS> timespan, ['2012-03-04 00:00:00', '2012-03-11 00:00:00']
THEMIS> iug_load_ear, datatype = 'troposphere'
THEMIS> ylim, 'iug_ear_trop_uwnd', 0, 20
THEMIS> ylim, 'iug_ear_trop_vwnd', 0, 20
THEMIS> ylim, 'iug_ear_trop_wwnd', 0, 20
THEMIS> ylim, 'iug_ear_trop_dpl1', 0, 20
THEMIS> ylim, 'iug_ear_trop_pwr1', 0, 20
THEMIS> ylim, 'iug_ear_trop_wdt1', 0, 20
THEMIS> ylim, 'iug_ear_trop_pn1', 40, 80
THEMIS> zlim, 'iug_ear_trop_uwnd', -20, 20
THEMIS> zlim, 'iug_ear_trop_vwnd', -20, 20
THEMIS> zlim, 'iug_ear_trop_wwnd', -2, 2
THEMIS> zlim, 'iug_ear_trop_dpl1', -2, 2
THEMIS> zlim, 'iug_ear_trop_pwr1', 20, 100
THEMIS> zlim, 'iug_ear_trop_wdt1', 0, 5
THEMIS> tplot_options, 'region', [0.05, 0, 1, 1]
THEMIS> tplot, ['iug_ear_trop_uwnd', 'iug_ear_trop_vwnd', 'iug_ear_trop_wwnd', 'iug_ear_trop_dpl1', 'iug_ear_trop_pwr1',
          'iug_ear_trop_wdt1', 'iug_ear_trop_pn1']
```

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: '2012-03-04 00:00:00' and Stop Time: '2012-03-11 00:00:00'.
Step 6:   Choose Instrument Type: 'Equatorial_Atmosphere_Radar'.
Step 7:   Choose Data Type: 'troposphere', Site or parameter(s)-1: '*(all)' and parameter(s)-2:
Step 8:   'uwnd','vwnd','wwnd','pwr1','wdt1','dpl1','pn1'.
Step 9:   Push [->] button. (Please wait a few minutes).
Step 10:  Push [Done] button.
Step 11:  Choose [Graph] -> [Plot Layout Options].
```

Information of observatory
This information is very helpful for writing scientific papers.

Information of basic commands of SPEDAS (CUI)
Load and plot the data.

Information of advanced commands of SPEDAS
Customize the data plot, and conduct the advanced analysis.

Information of flow chart of SPEDAS (GUI)
Load, and plot the data.

2. How to use IUGONET Type-A

2.6 Exercise (2.2～2.5 items)

Let's try IUGONET Type-A

You try to search various kinds of ground-based observation data related to equatorial atmosphere with IUGONET Type-A.

For example, automatic weather station (AWS), wind profiler radar, EAR, radiosonde etc.

If you have some time, please try to search other datasets (solar, geomagnetic field, ionospheric plasma, air glow etc.)

Time limit: 15 – 20 minutes

If you have any questions and suggestions on this exercise and IUGONET Type-A, please let me know them.

Section 3

How to use an integrated data analysis software: SPEDAS

3. How to use SPEDAS

3.0 Contents in this section

- **To Learn a basic use of SPEDAS-GUI**
  1. **Start of the GUI tool**
  2. **Load data**
  3. **Plot loaded data**
  4. **Output the plot image file**
  5. **Save the loaded data**
  6. **Save the working contents**
  7. **Customize the plot**
  8. **Simple data analysis (average, filter, FFT, wavelet etc.)**
- **Data set**
  - **EAR, meteor/MF radar, radiosonde, AWS, WPR etc.**
  - **Various kinds of upper atmospheric data from IUGONET**

3. How to use SPEDAS

3.1 Download and installation of SPEDAS GUI tool

1. Access the SPEDAS homepage
http://spedas.org/wiki/index.php?title=Downloads_and_Installation

If you don't have an IDL license

SPEDAS is free software but if you do not have an IDL license, then you cannot use the IDL command line, and hence neither the SPEDAS command line tools. You can still use the SPEDAS GUI, and you have two options:

1. Download the SPEDAS executable (for Linux, MacOS, or Windows), or
2. Download the SPEDAS save file (for Solaris or other operating systems).

Download the SPEDAS executables, Version 3.1.1 (October 2018, minor refresh January 2019)

Note: In January 2019, we created new executable files (spedas version 3.1.1). However, the only change is the correction of a single bug in the executables, the underlying spedas code remains that of October 2018.

For users without IDL licenses, you can use the SPEDAS 3.1.1 executable files for Linux, Windows, and MacOS, which allow access to the Graphical User Interface capabilities of SPEDAS, with no additional IDL license required.

* SPEDAS 3.1.1, Windows 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~55 MB)
* SPEDAS 3.1.1, MacOs 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~70 MB)
* SPEDAS 3.1.1, Linux 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 10.5 (~70 MB)
* SPEDAS 3.1.1, Linux 64bit executable with IDL 8.5.1, CDF 3.6.3.1, Geopack 7.6 (~70 MB) - includes Geopack 7.6, for older Linux machines that have problems with Geopack 9.4

This release contains everything you need, including the IDL VM, the Geopack DLM and the CDF DLM. You just have to unzip the file and run the executable and the SPEDAS GUI will appear.

Download the SPEDAS save file, Version 3.1.1 (October 2018, minor refresh January 2019)

Note: In January 2019, we created a new save file (spedas version 3.1.1). However, the only change is the correction of a single bug, the underlying spedas code remains that of October 2018.

The SPEDAS save file requires the run-time IDL Virtual Machine (VM) which has to be downloaded for free from H

* SPEDAS 3.1.1, IDL Savefile (20 MB)

To run SPEDAS using the IDL virtual machine,

1. start the IDL virtual machine executable
2. click through the splash screen to get to the file selection dialog
3. navigate to the SPEDAS installation
4. go into the thm_gui_new directory and click on thm_gui.sav

This should bring up the main screen of the SPEDAS GUI. From this point you should be able to load, plot, and anal

Further information for loading IDL save files can be found here: http://harrisgeospatial.com/docs/StartingVirtualMachineApplication.html

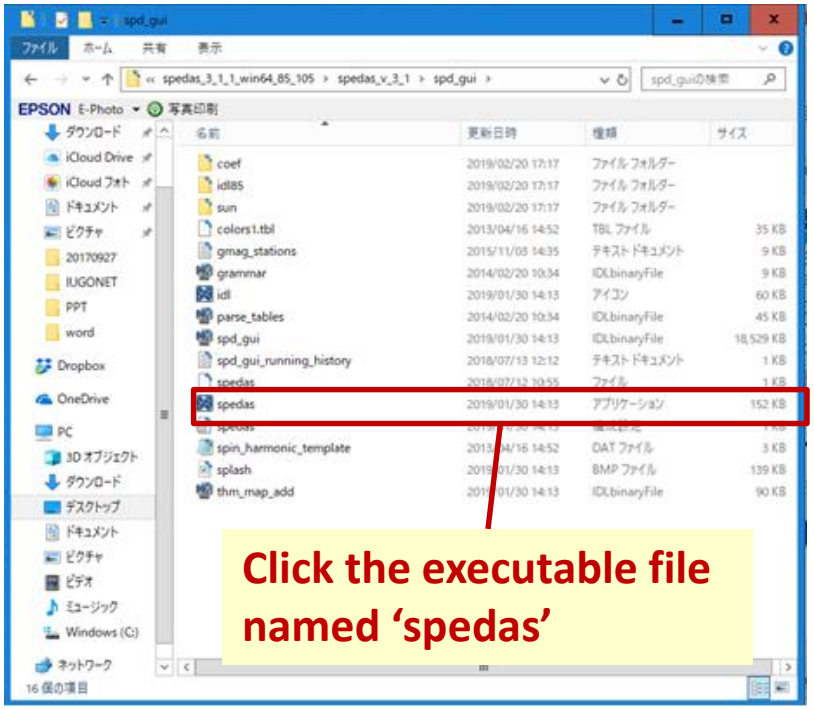
2. Click the proper link for your OS. The compressed executable file will be downloaded in several seconds or minutes.

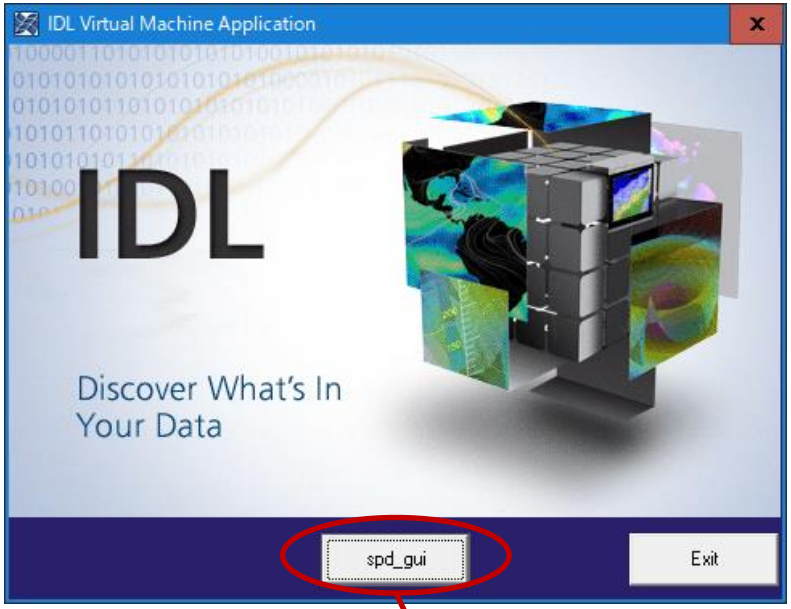
3. How to use SPEDAS

3.2 Start of SPEDAS GUI tool

[1] Unzip the downloaded zip file.

[2] Click the executable file named ‘spedas’ stored in the directory ‘spd_gui’.



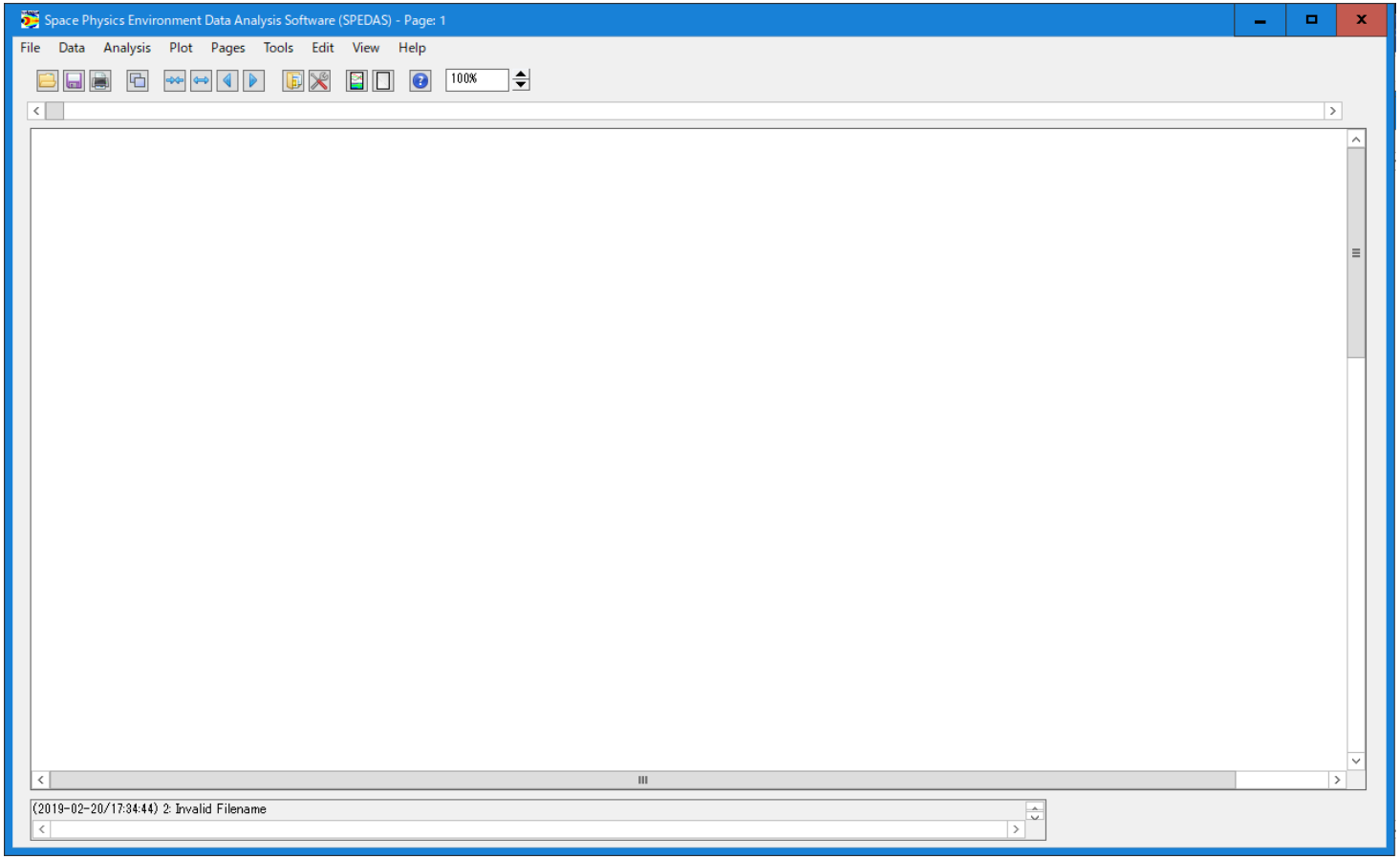


[3] Because the IDL Virtual Machine window appears on your PC, you should click the icon ‘spd_gui’.

3. How to use SPEDAS

3.3 Start of SPEDAS GUI tool

Does this window appear ?



If the SPEDAS GUI starts normally, this window appears immediately.

3. How to use SPEDAS

3.4 Load and plot the EAR data

You can create the plots of the EAR data through only 12 steps!

From: IUGONET Type-A
http://search.iugonet.org/metadata/001/00000155

1. Start SPEDAS GUI Program.

2. Choose [Data] -> [Load Data from Plug-in].

3. Choose [IUGONET] Tab.

4. Uncheck 'Use Single Day'.

5. Set Start Time: '2012-03-04 00:00:00' and Stop Time: '2012-03-11 00:00:00'.

6. Choose Instrument Type: 'Equatorial_Atmosphere_Radar'.

7. Choose Data Type: 'troposphere', Site or parameter(s)-1: '*(all)' and parameter(s)-2: 'uwnd','vwnd','wwnd','pwr1','wdt1','dpl1','pn1'.

8. Push [->] button. (Please wait a few minutes).

9. Push [Done] button.

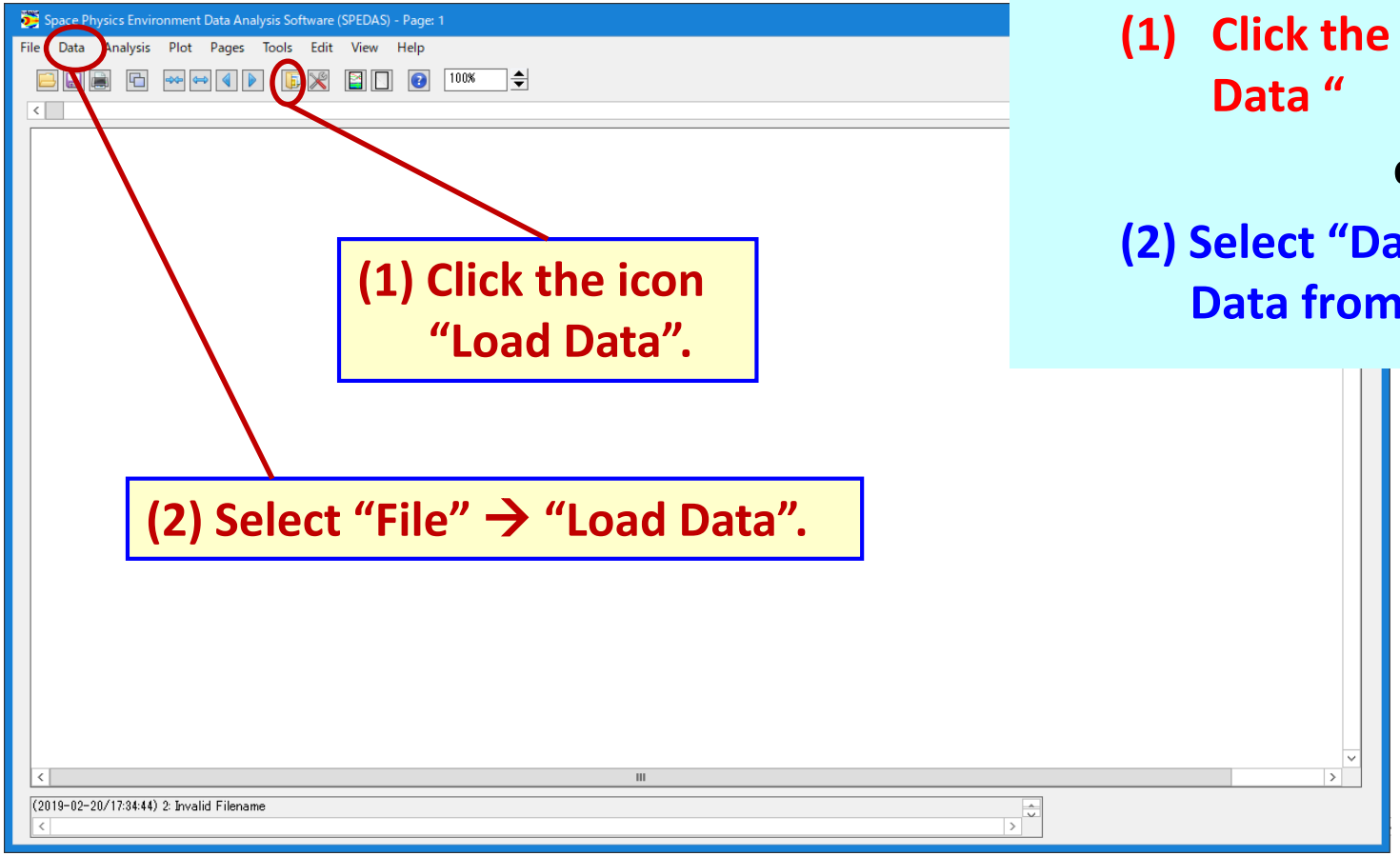
10. Choose [Plot] -> [Plot Layout Options].

11. Choose 'iug_ear_trop_uwnd', 'iug_ear_trop_vwnd', 'iug_ear_trop_wwnd', 'iug_ear_trop_dpl1', 'iug_ear_trop_pwr1', 'iug_ear_trop_wdt1', 'iug_ear_trop_pn1' and push [Line->] button.

12. Push [OK] button.

3. How to use SPEDAS

3.4 Load and plot the EAR data



[4] Start of Load Data Window with the following method.

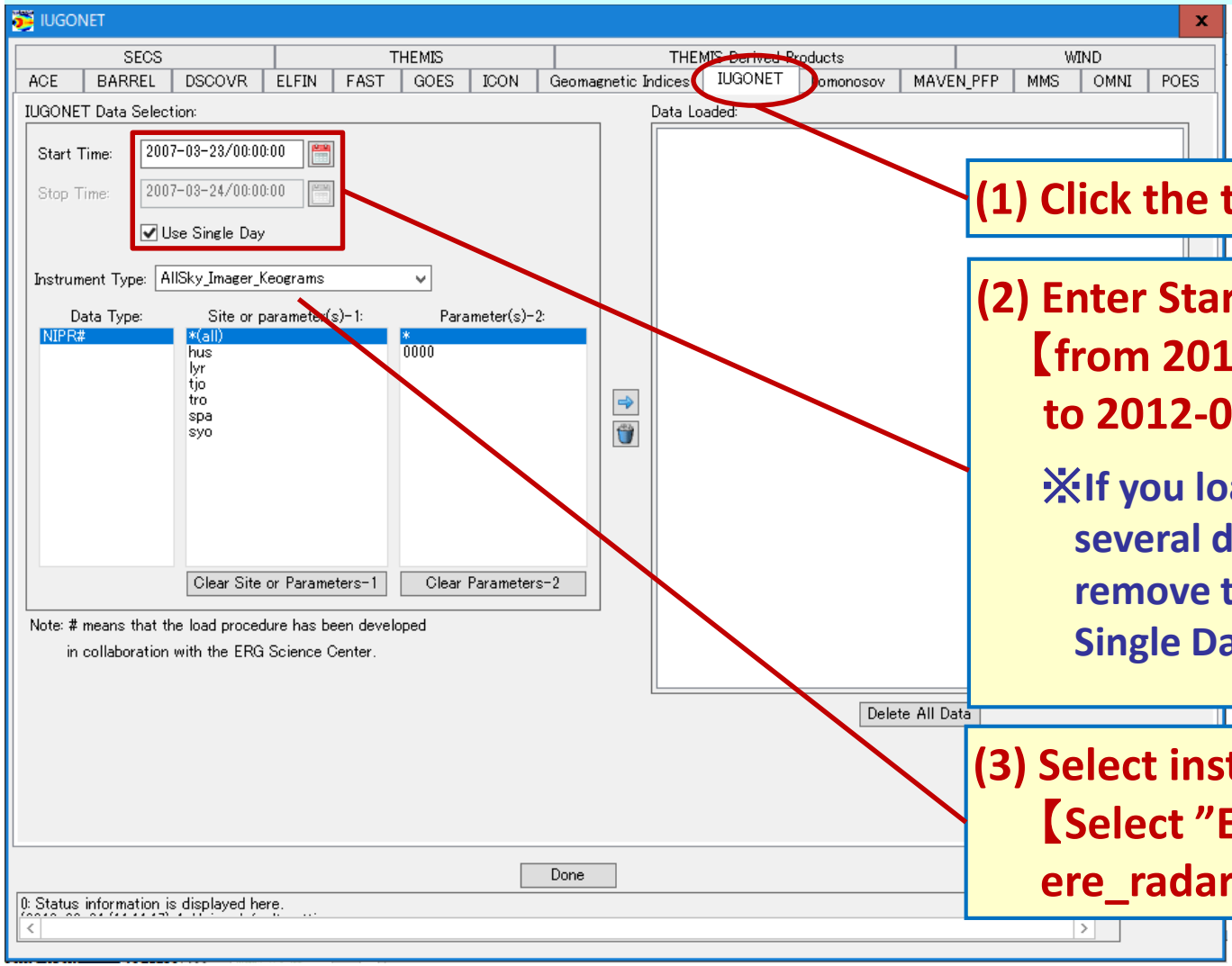
(1) Click the icon " Load Data "

or

(2) Select "Data" → "Load Data from Plug-in"

3.4 Load and plot the EAR data

[5] To select the data name you want to load on the Load Data Window



(1) Click the tab "IUGONET"

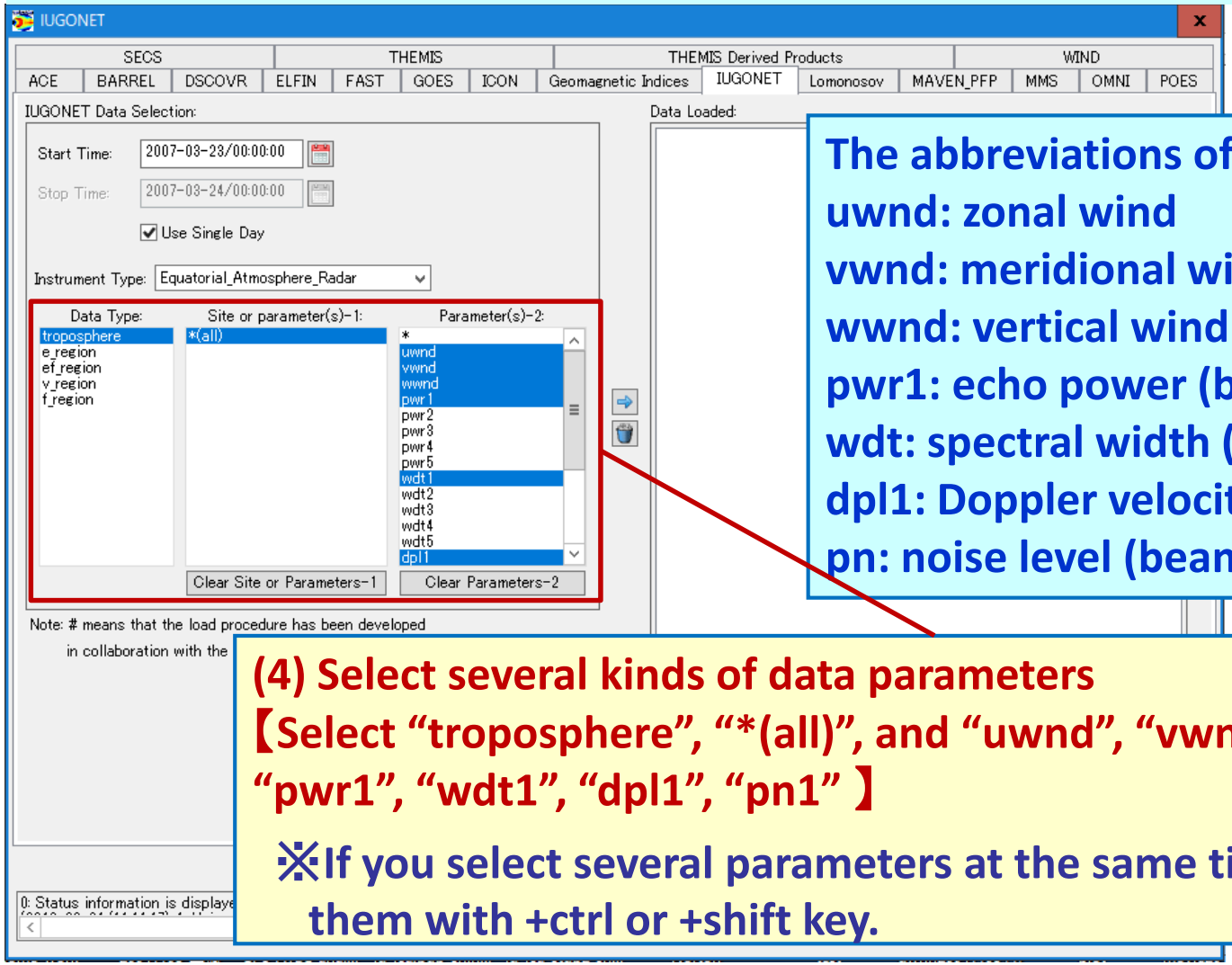
(2) Enter Start/Stop Time
【from 2012-03-04/00:00:00 to 2012-03-11/00:00:00】

※If you load the data during several days, you have to remove the check "Use Single Day".

(3) Select instrument.
【Select "Equatorial_Atmosphere_radar"】

3.4 Load and plot the EAR data

[5] To select the data name you want to load on the Load Data Window



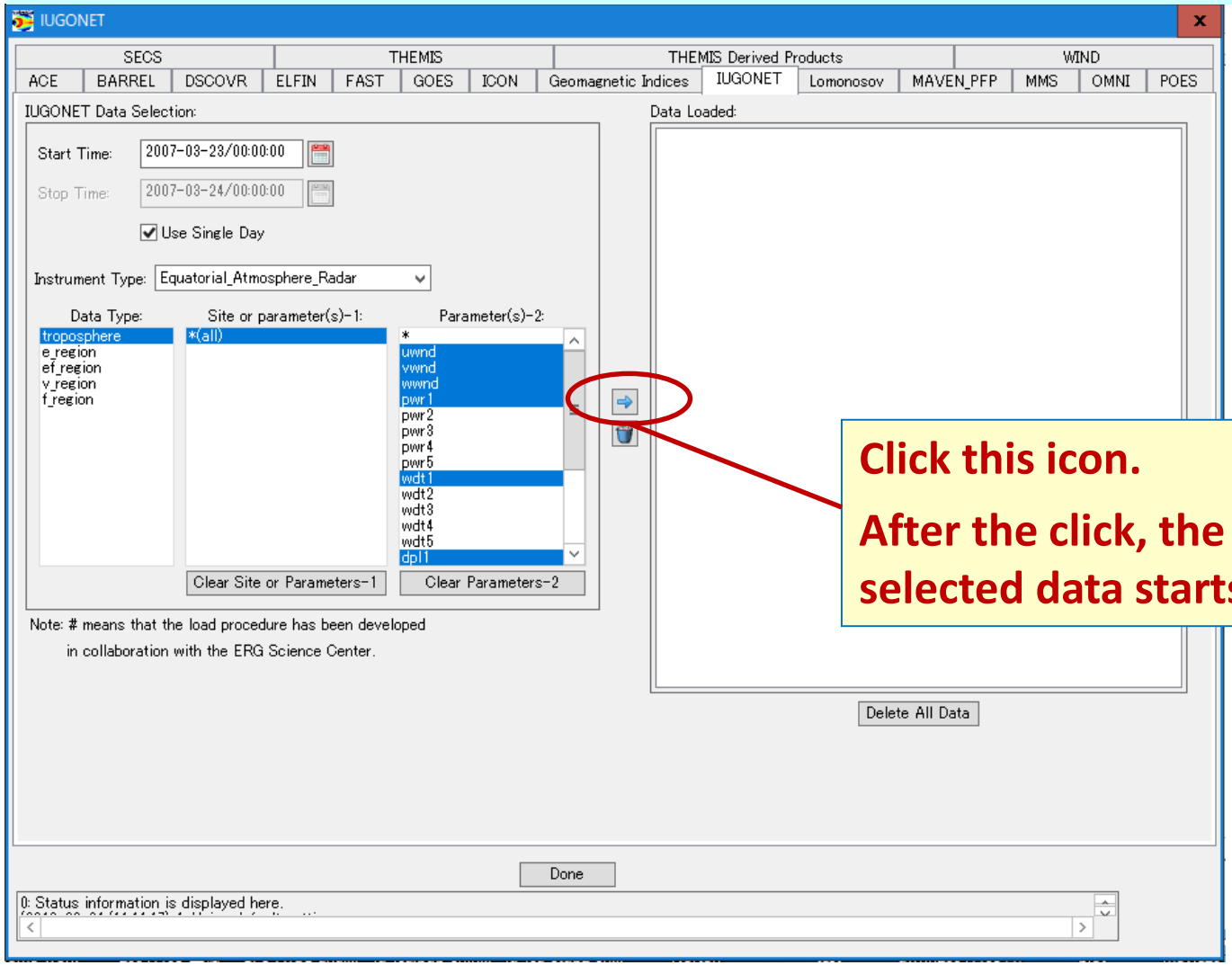
The abbreviations of parameter mean
uwnd: zonal wind
vwnd: meridional wind
wwnd: vertical wind
pwr1: echo power (beam-1)
wdt: spectral width (beam-1)
dpl1: Doppler velocity (beam-1)
pn: noise level (beam-1

(4) Select several kinds of data parameters
【Select “troposphere”, “*(all)”, and “uwnd”, “vwnd”, “wwnd”, “pwr1”, “wdt1”, “dpl1”, “pn1” 】

※If you select several parameters at the same time, you select them with +ctrl or +shift key.

3.4 Load and plot the EAR data

[5] To select the data name you want to load on the Load Data Window

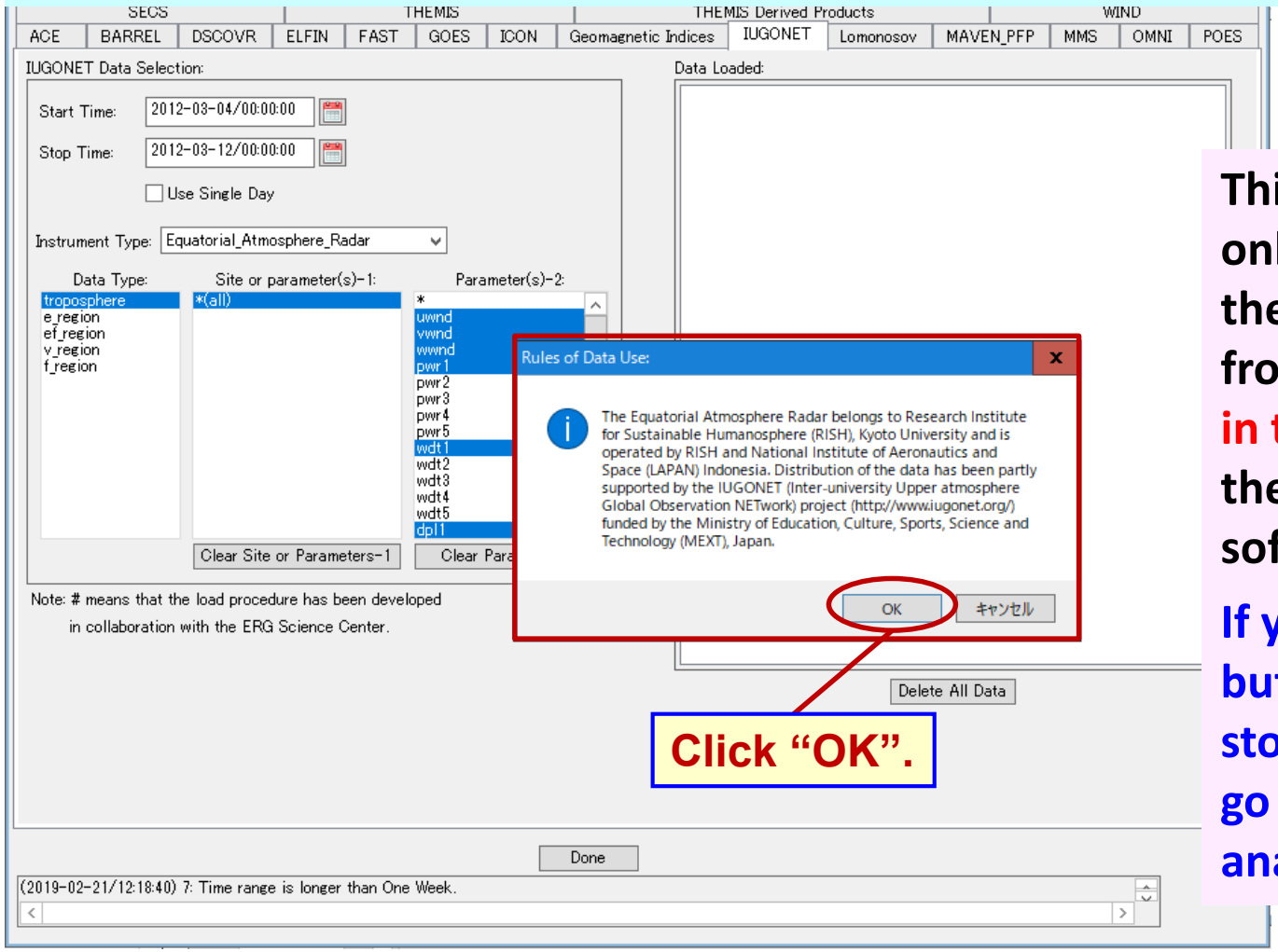


Click this icon.

After the click, the load of selected data starts.

3.4 Load and plot the EAR data

[6] After you carefully read “Rules of Data Use” described on a new window, please click the button “OK”.

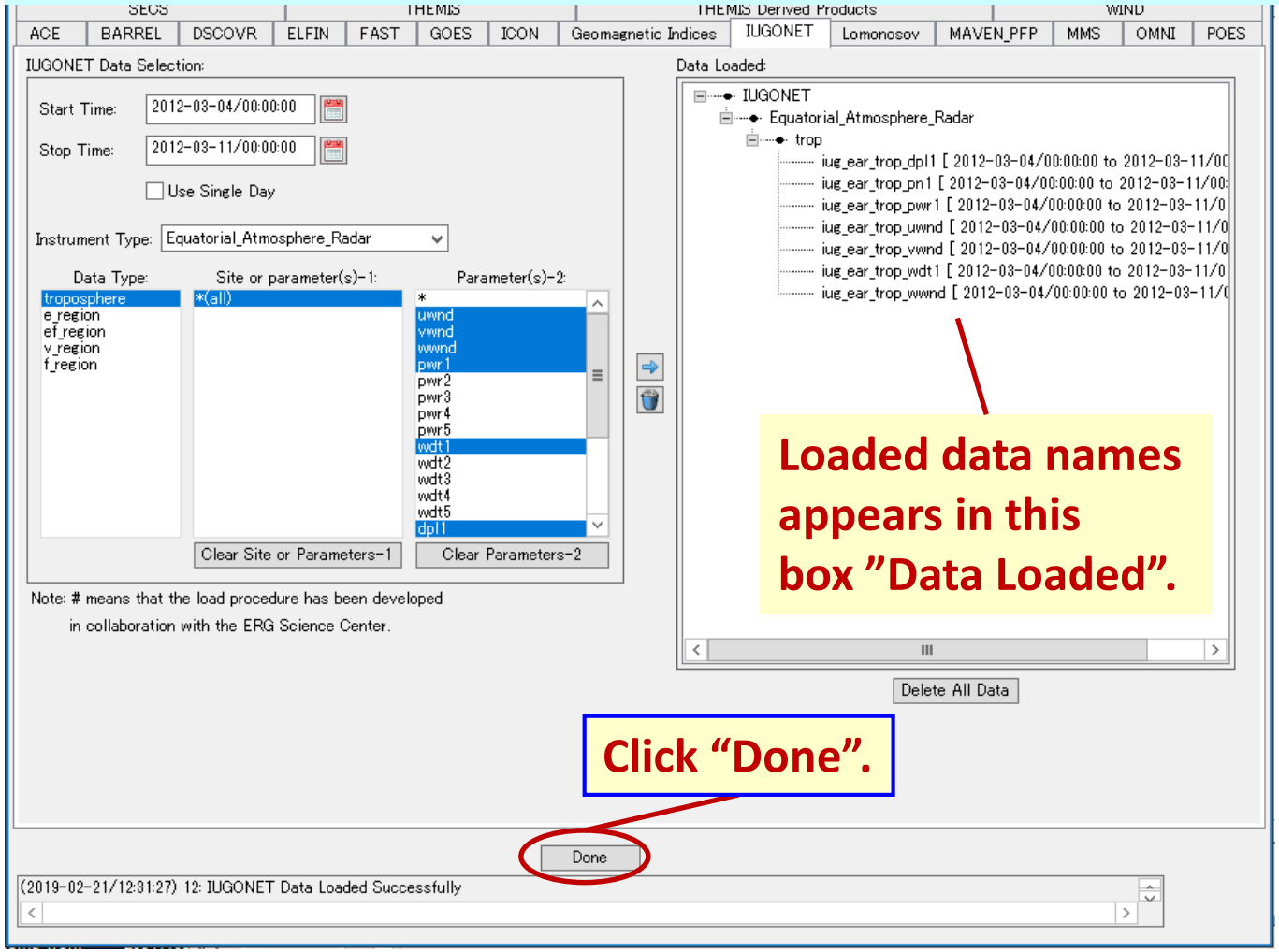


This window appears only when you loaded the data obtained from each instrument in the first time after the start of this software.

If you push the cancel button, the data load stops and you cannot go ahead of data analysis.

3.4 Load and plot the EAR data

[7] Please confirm whether the loaded data appear in the right box “Data Loaded” or not.



3. How to use SPEDAS

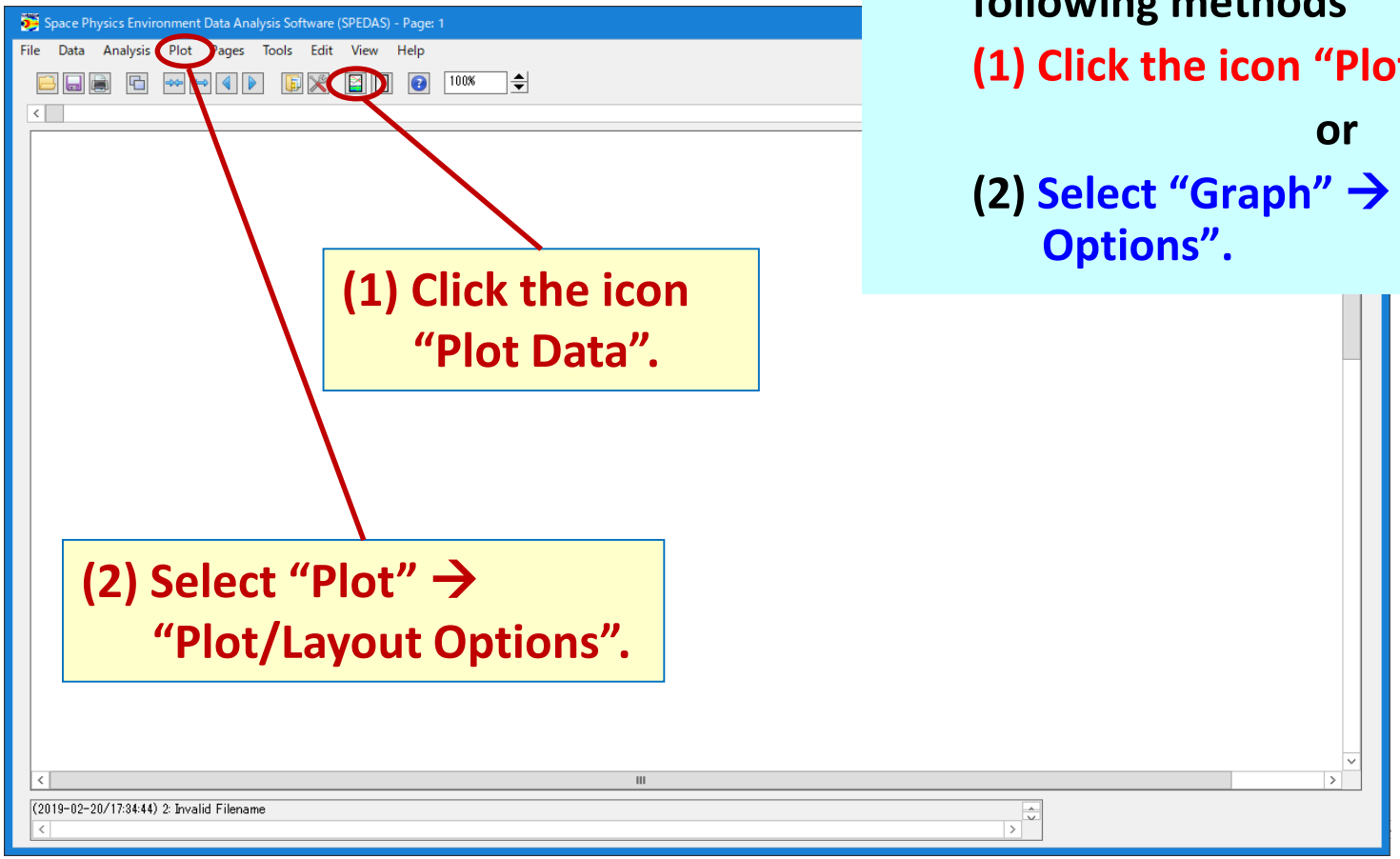
3.4 Load and plot the EAR data

[8] You open the "Plot/Layout Options Window" with one of the two following methods

(1) Click the icon "Plot Data".

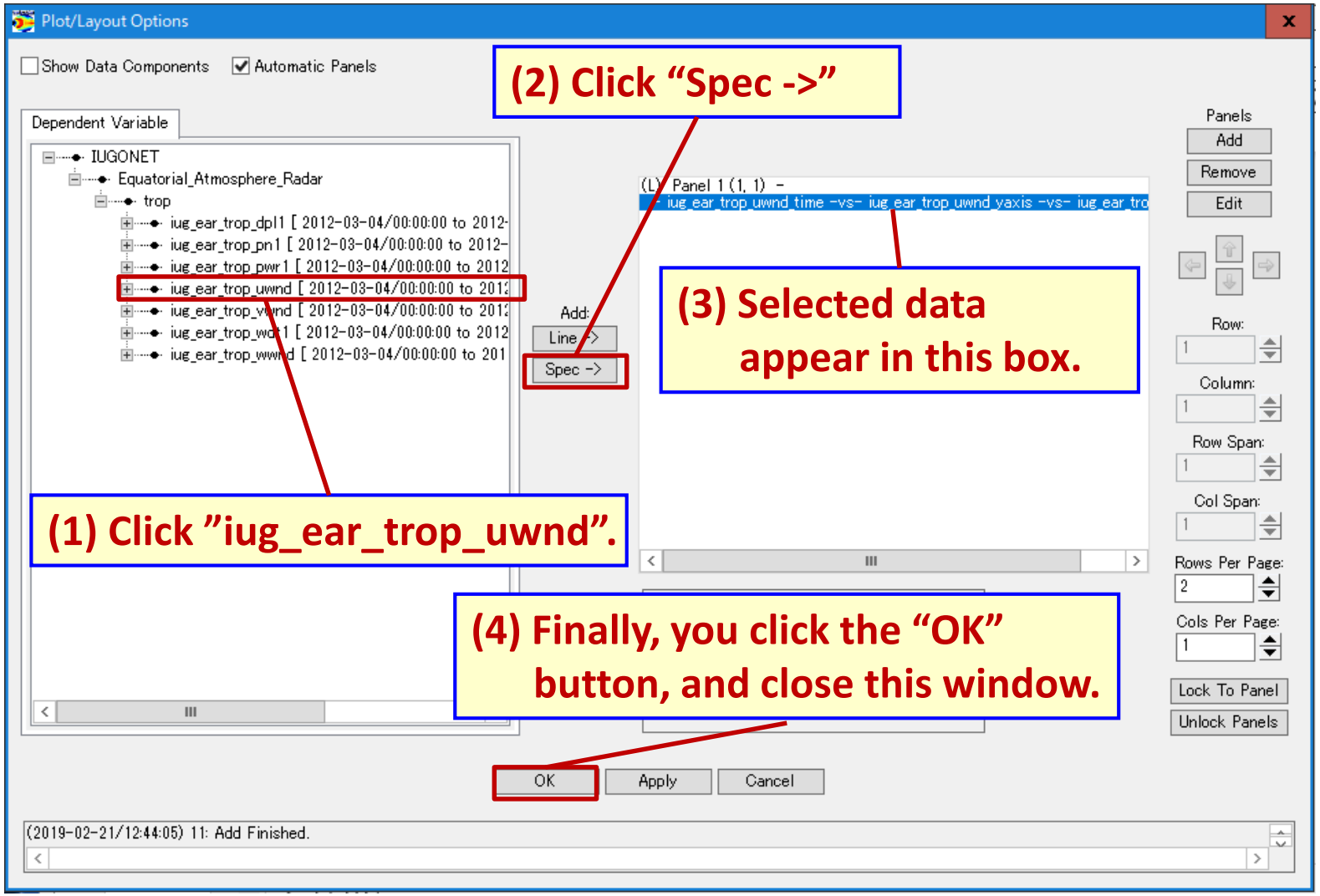
or

(2) Select "Graph" → "Plot/Layout Options".



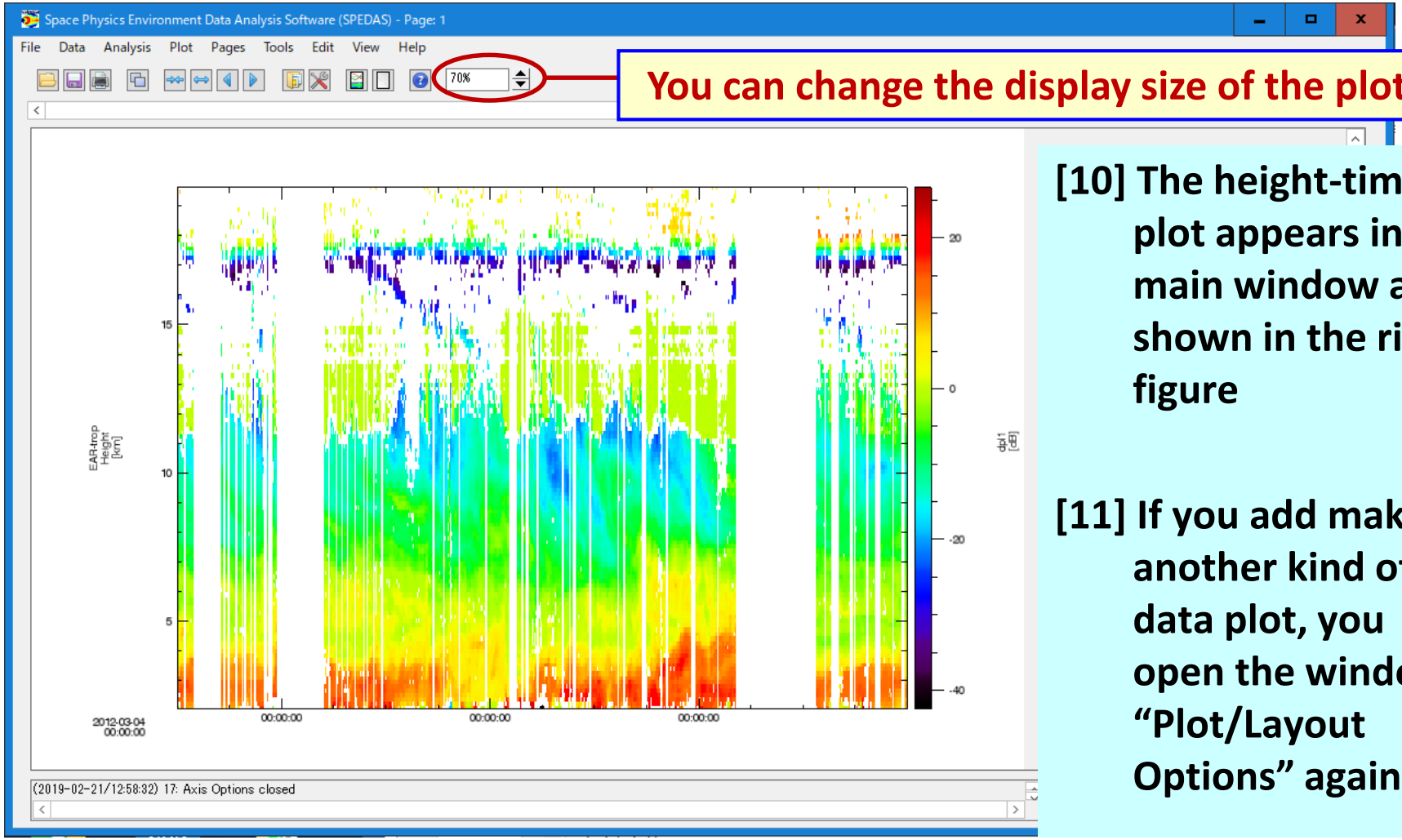
3.4 Load and plot the EAR data

[9] To set up the layout of plot on the window “Plot/Layout Options”.



3. How to use SPEDAS

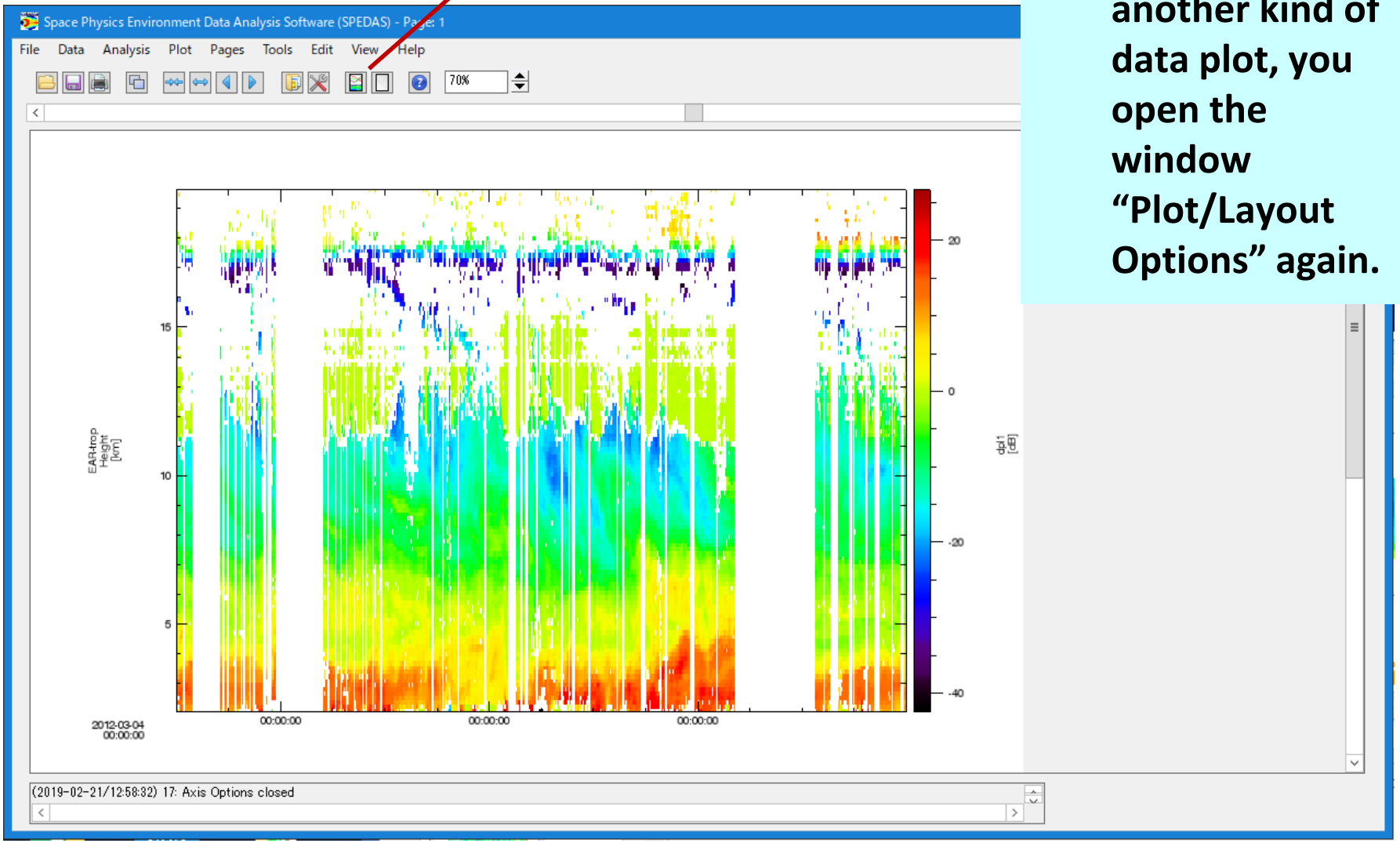
3.4 Load and plot the EAR data



[10] The height-time plot appears in the main window as shown in the right figure

[11] If you add make another kind of data plot, you open the window "Plot/Layout Options" again.

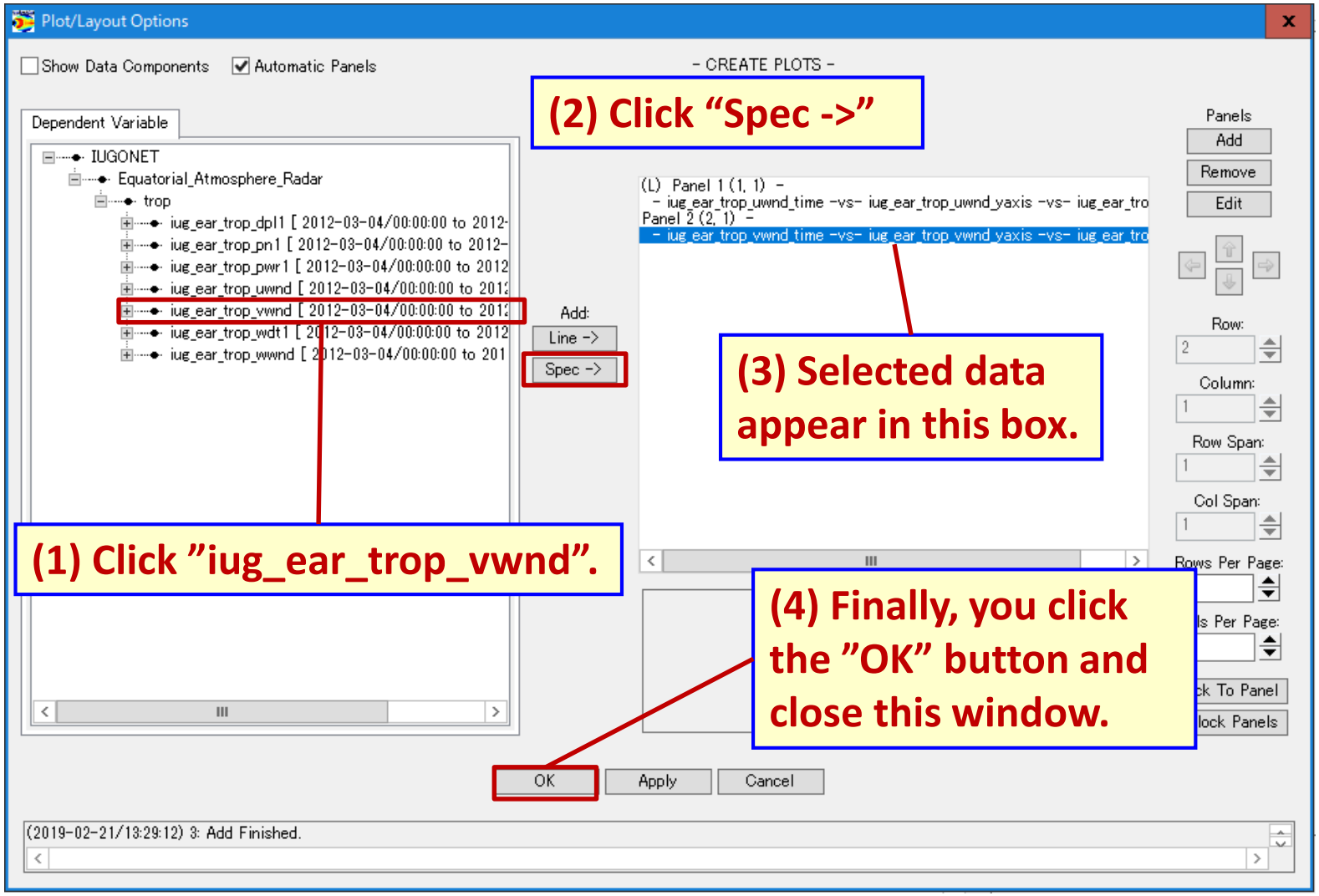
3.4 Load and plot the EAR data



[11] If you add make another kind of data plot, you open the window "Plot/Layout Options" again.

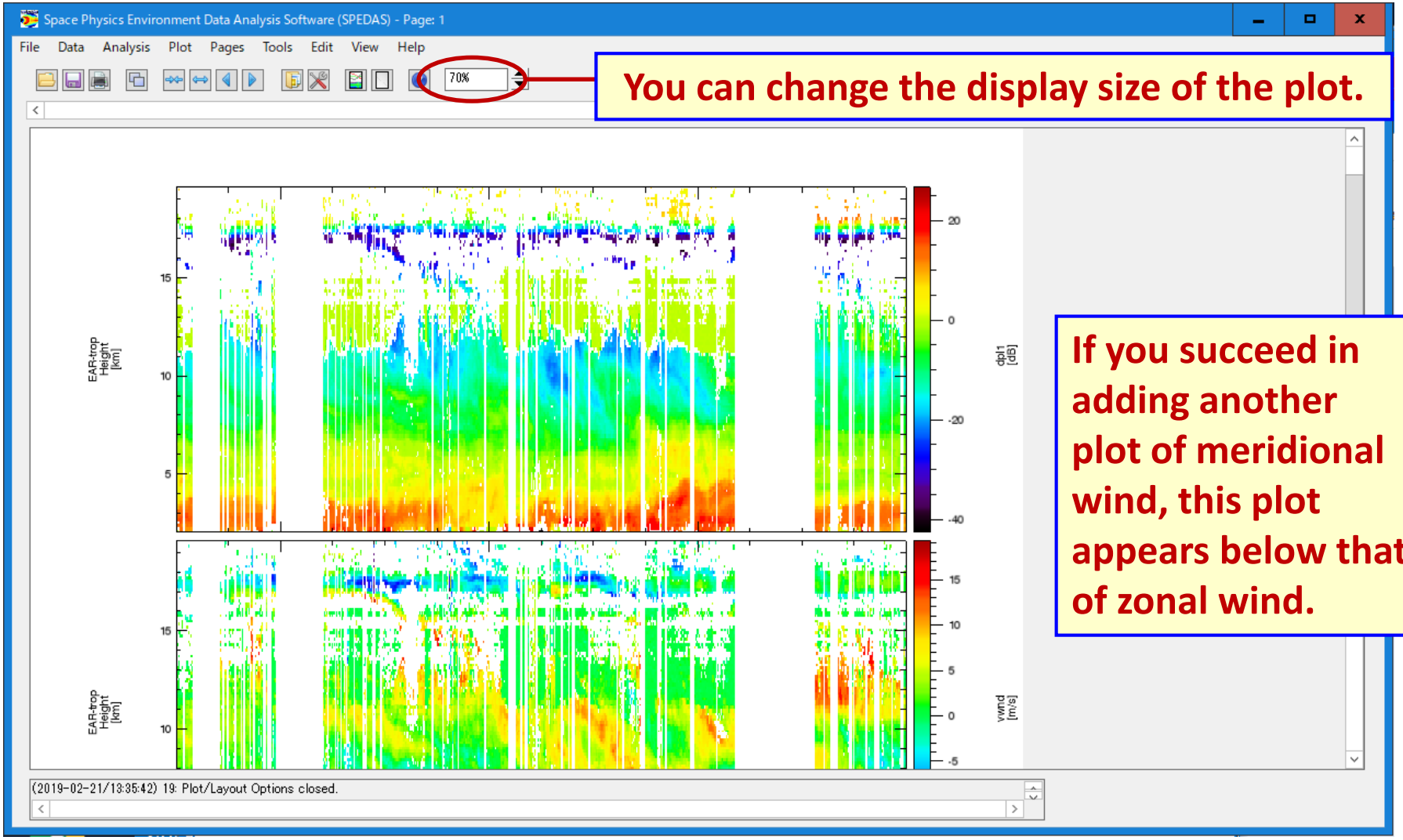
3.4 Load and plot the EAR data

[12] To add the new plot data with the following procedure

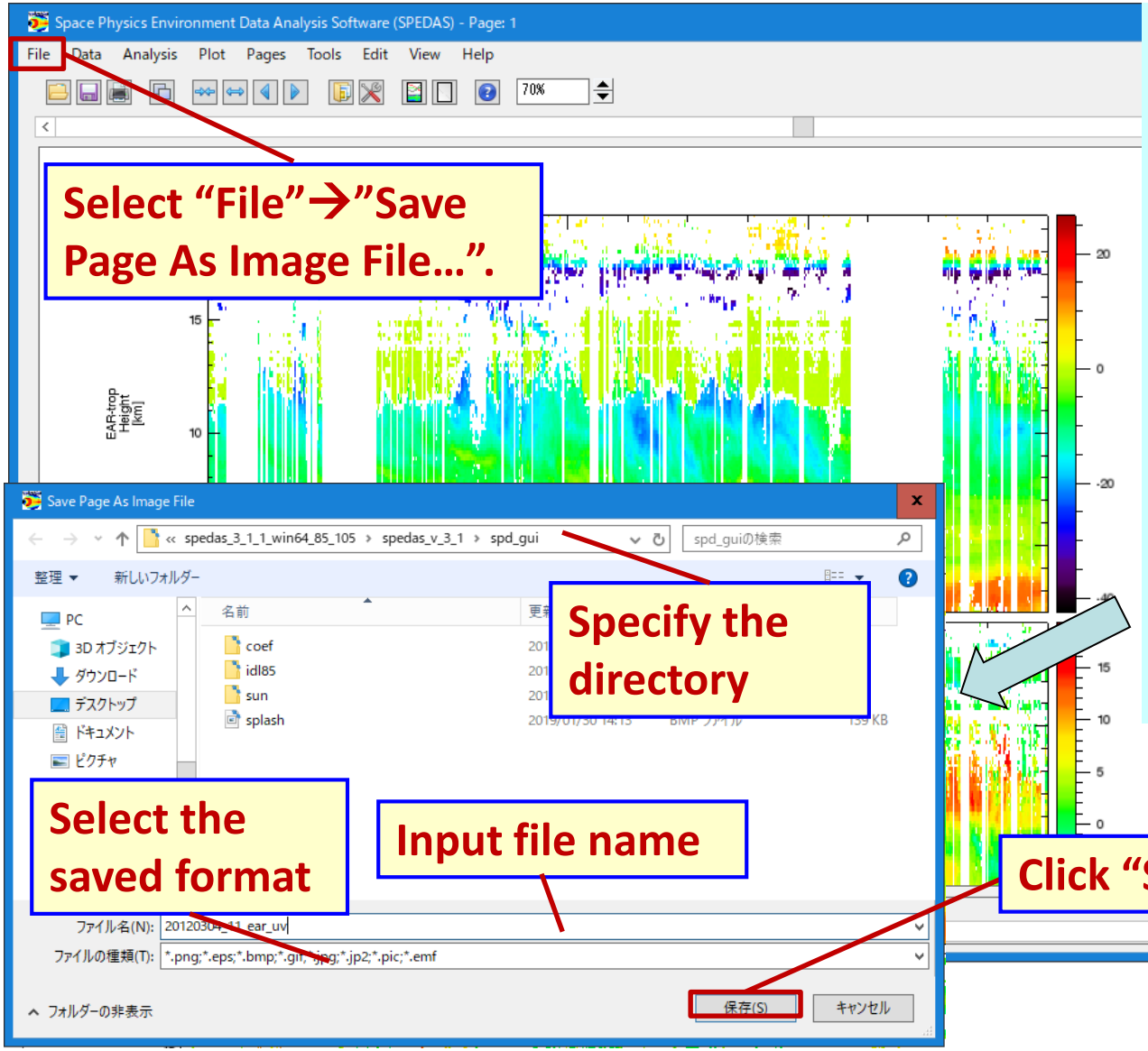


3. How to use SPEDAS

3.4 Load and plot the EAR data



3.5 Output of plot image file

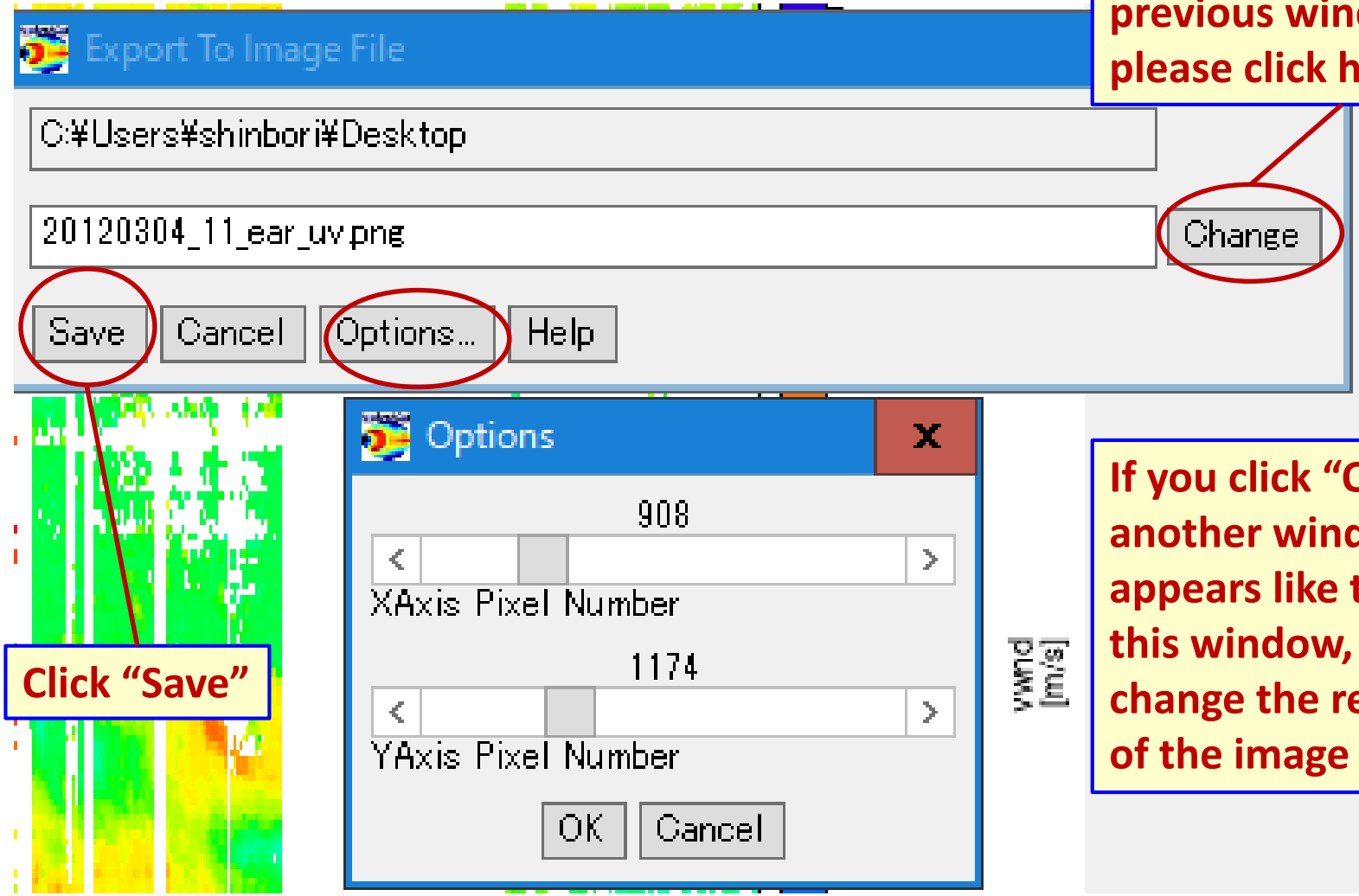


[13] In order to output the plot image file, you select “File” → “Save Page As Image File …” on the main window.

[14] Specify the file format, name and save location and click the “SAVE” button on the Save Image window.

3.5 Output of plot image file

Conformation window



If you go back to the previous window, please click here.

Click "Save"

If you click "Options…", another window appears like this. In this window, you can change the resolution of the image data.

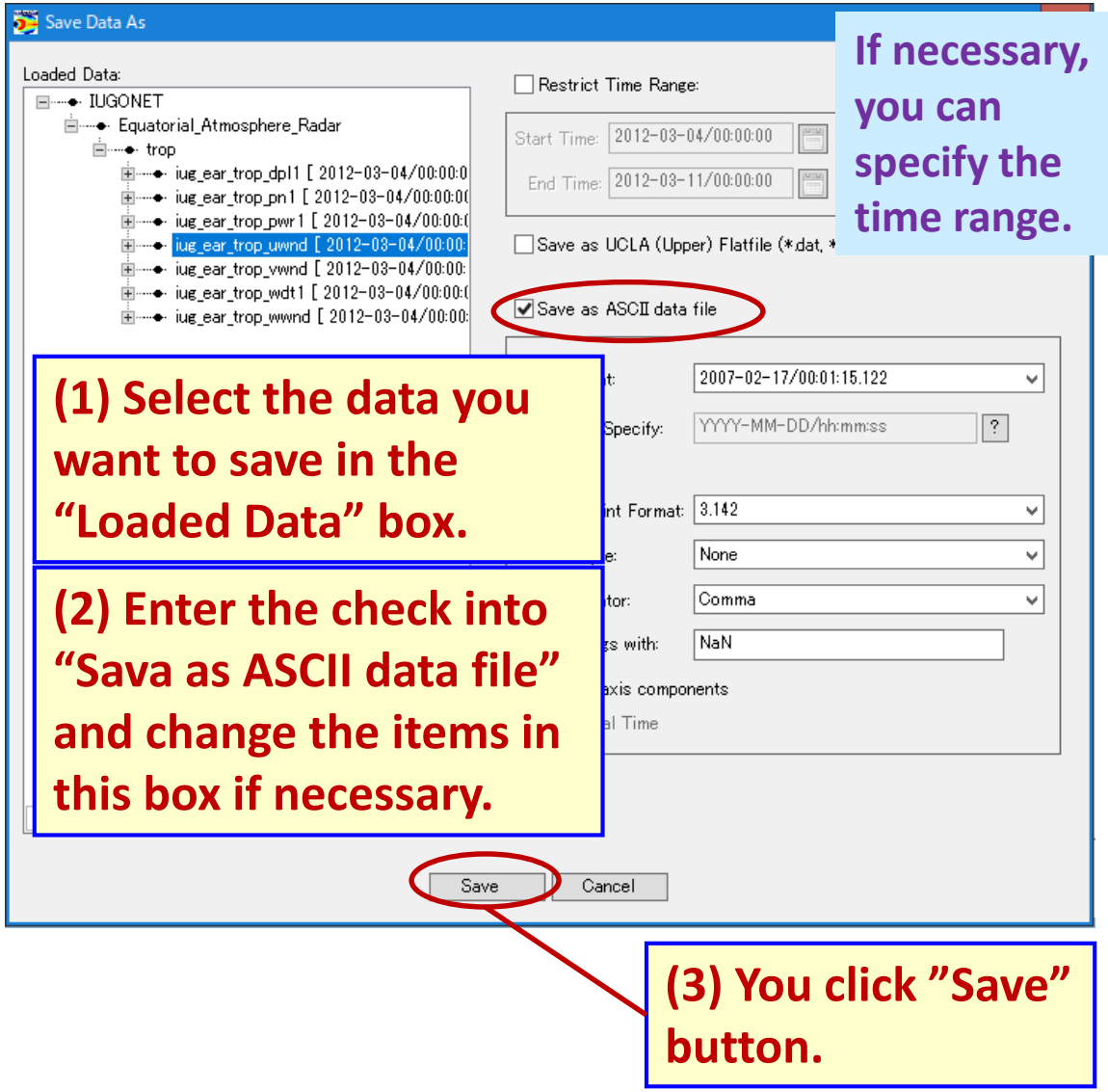
3. How to use SPEDAS

3.6 Save the EAR data in ascii (text) format

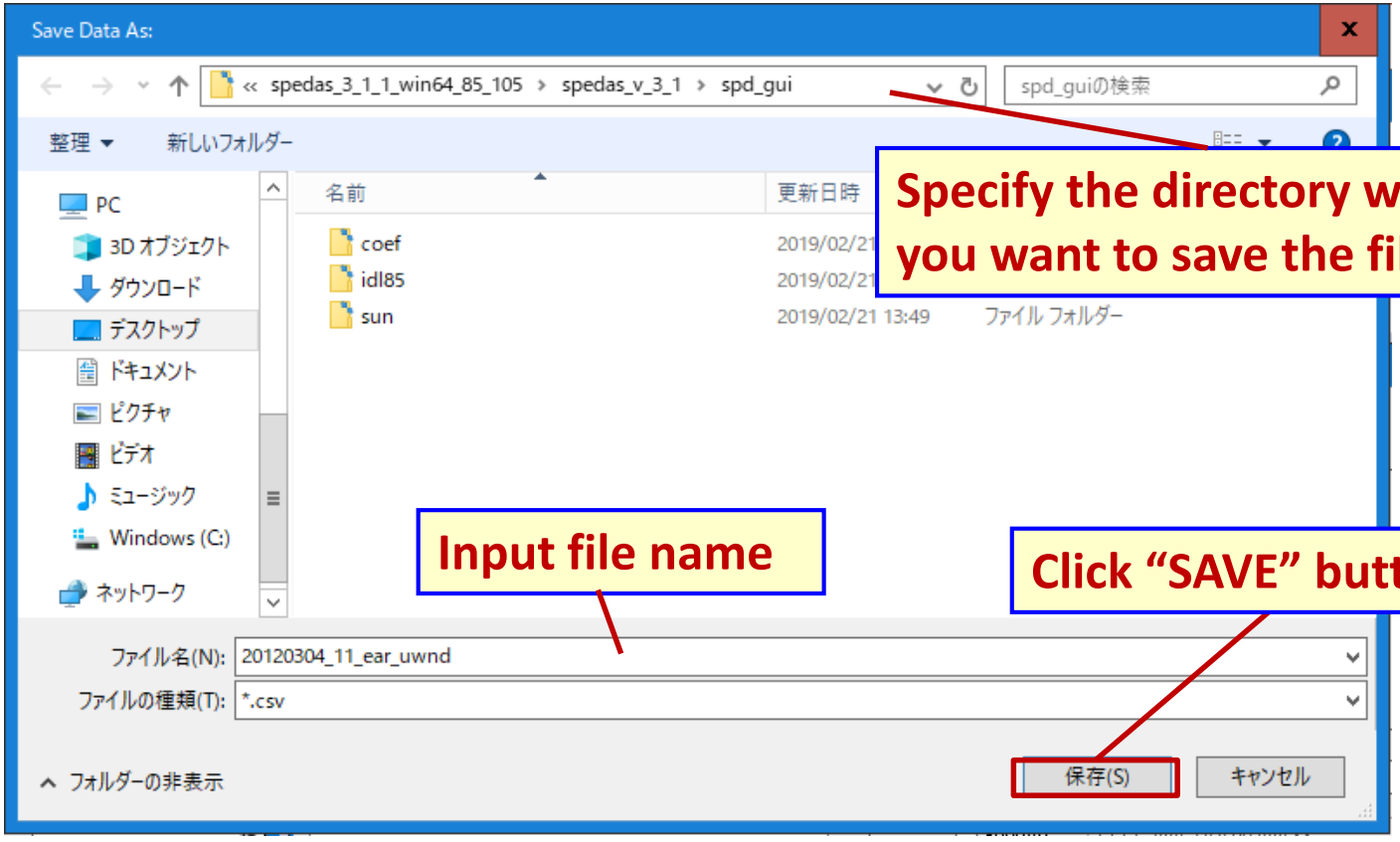
[15] If you save the loaded data in ascii format, you first select "Data" → "Save Data As…" on the main window.

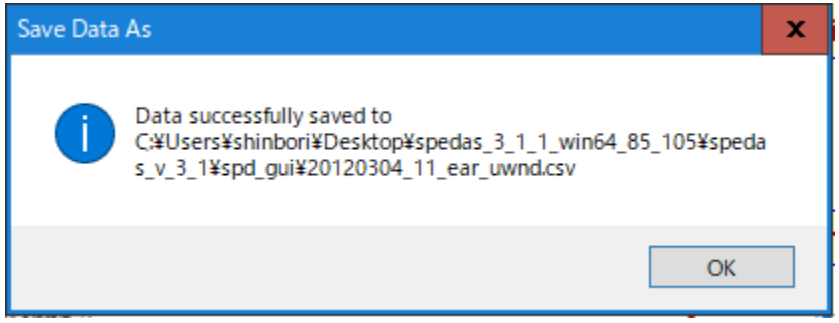
[16] You specify several items on the "Save Data As" window as shown in the right figure, and click the "Save" button after you check "Save as ASCII data file".

[17] You click the "OK" button in this window.



3.6 Save the EAR data in ascii (text) format

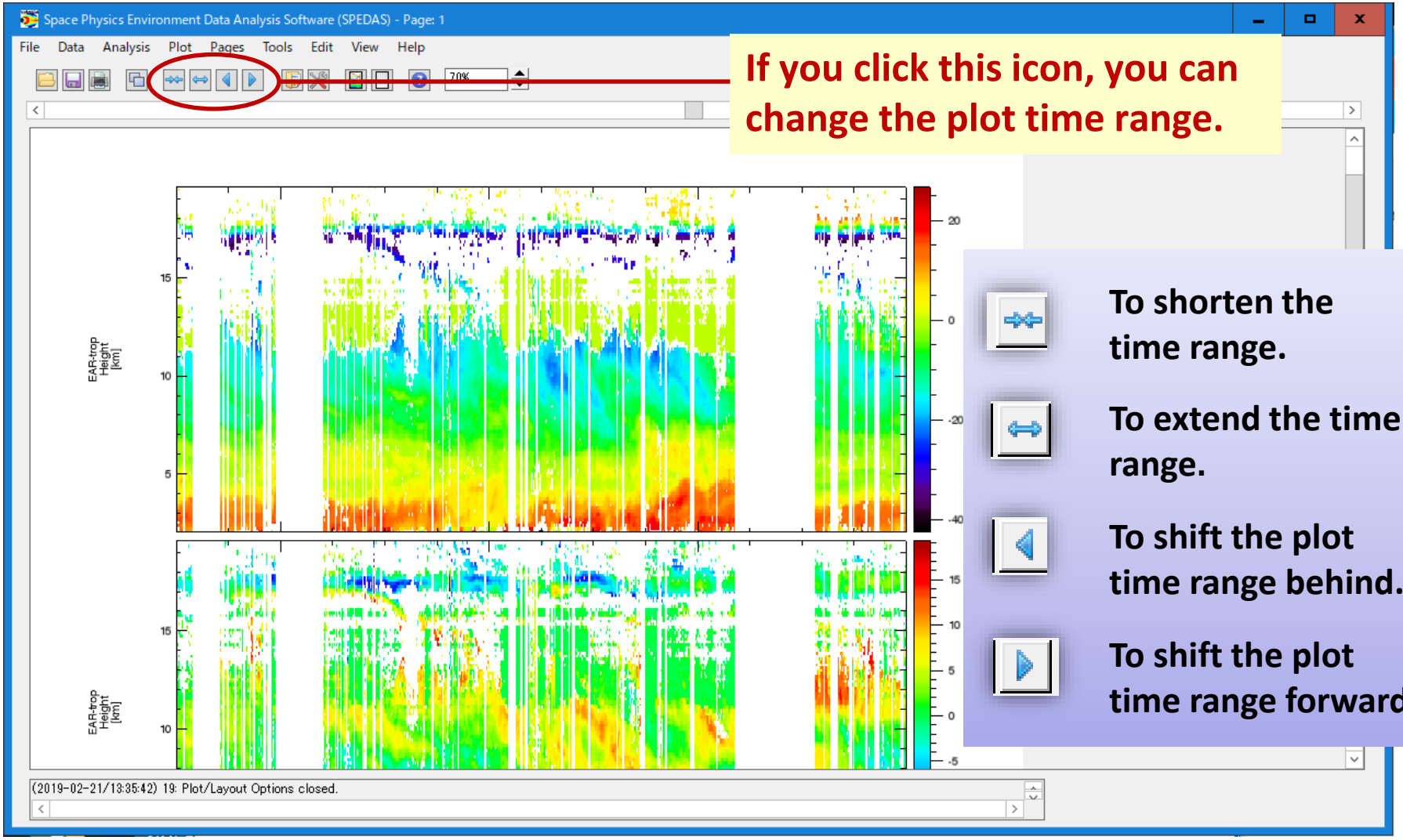




When you successfully save the data in ASCII format, this another window appears.
→Click “OK” button.

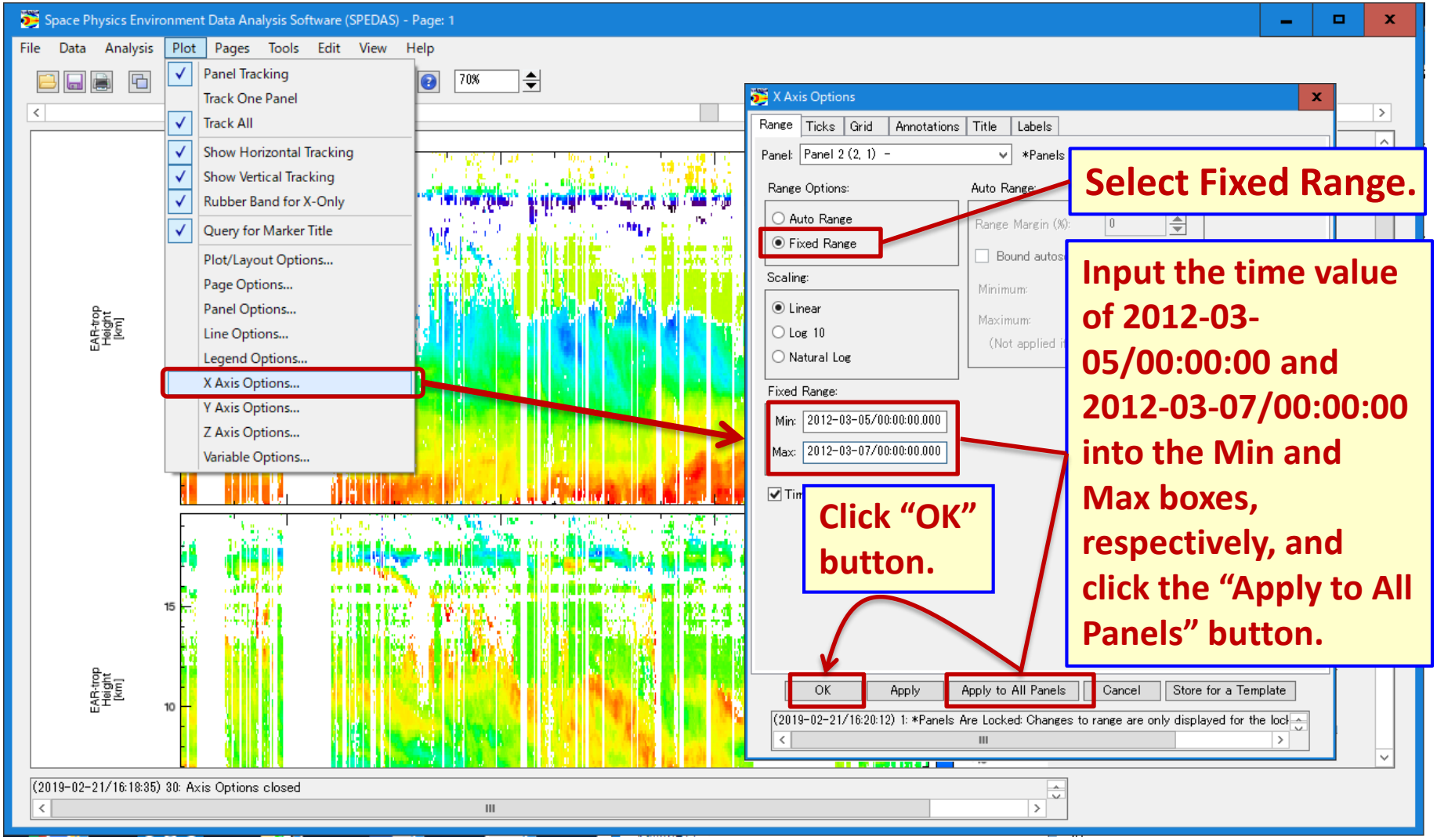
3. How to use SPEDAS

3.7 Customize the data plot (change the plot time range)



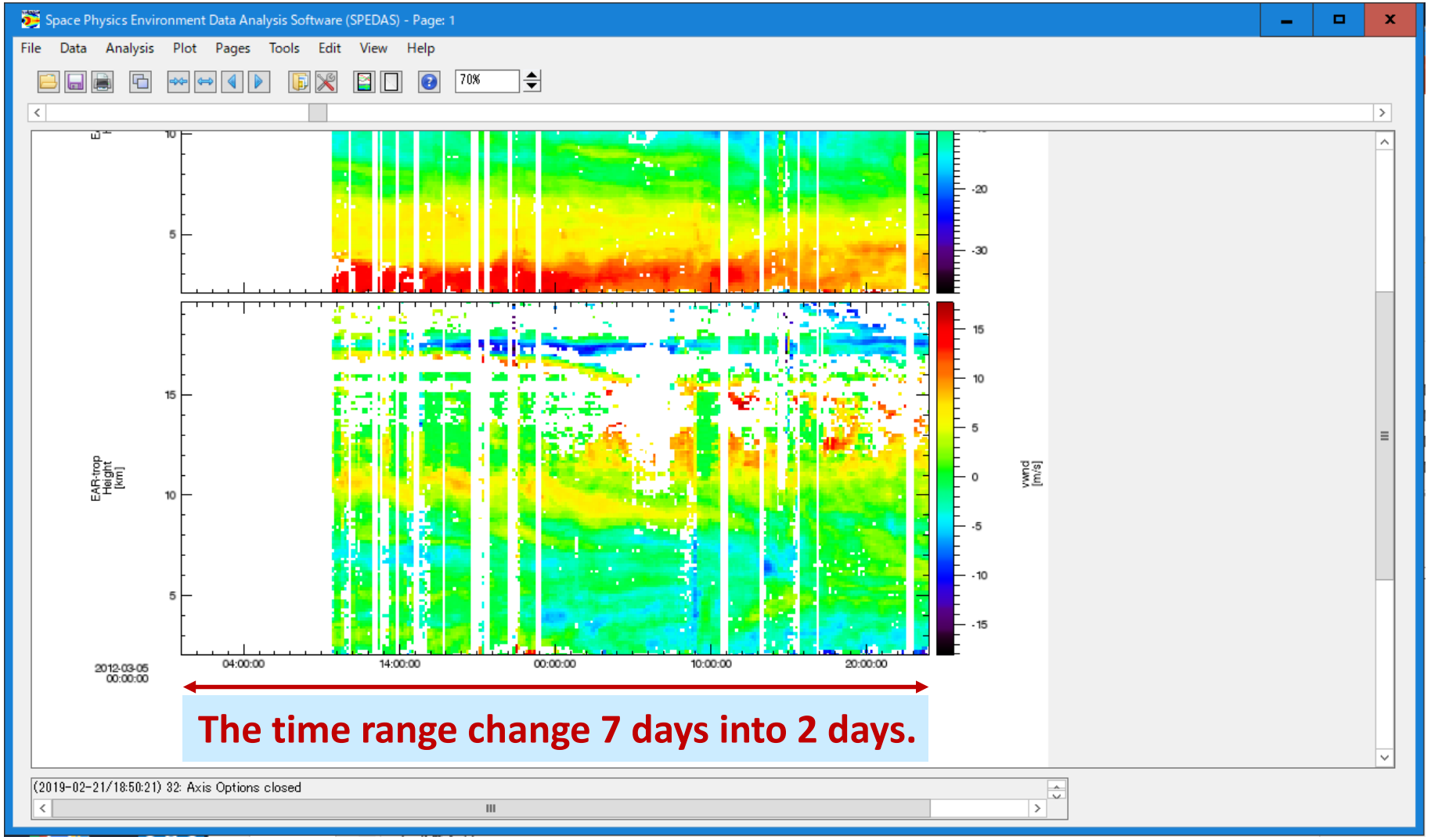
3. How to use SPEDAS

3.7 Customize the data plot (change the plot time range)



3. How to use SPEDAS

3.7 Customize the data plot (change the plot time range)



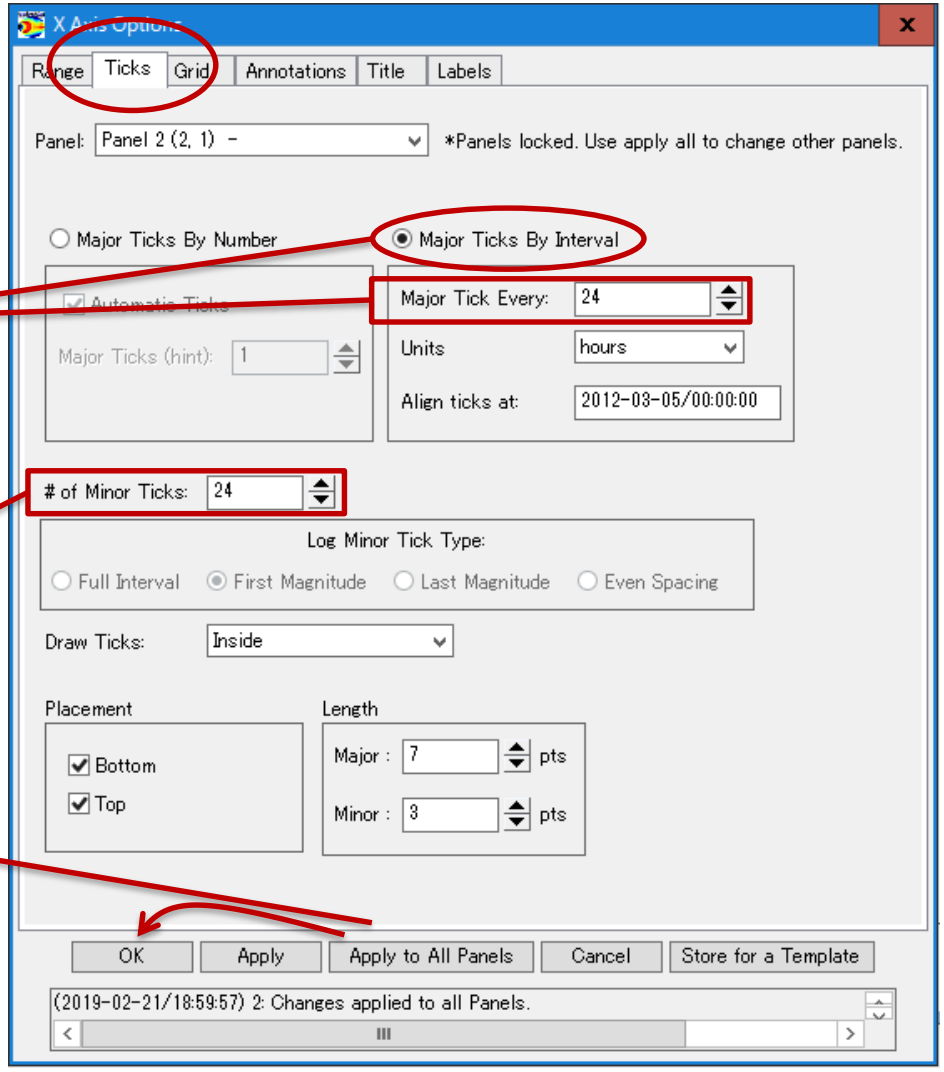
3.7 Customize the data plot (change the time ticks)

You can freely customize the plot Tick on the Ticks tab.

Select Major Tick By Interval and change the Major Tick Every into 24 hours.

You specify the # of Minor Ticks as 24. That is, 24 Minor Ticks are represented in 1 hour.

Finally, you click "Apply to All Panels" → "OK".



3. How to use SPEDAS

3.7 Customize the data plot (change the time format)

You can change the time format on the Annotation tab.

Select "mo:day:h:m" in the pull-down menu of the Annotation Format.

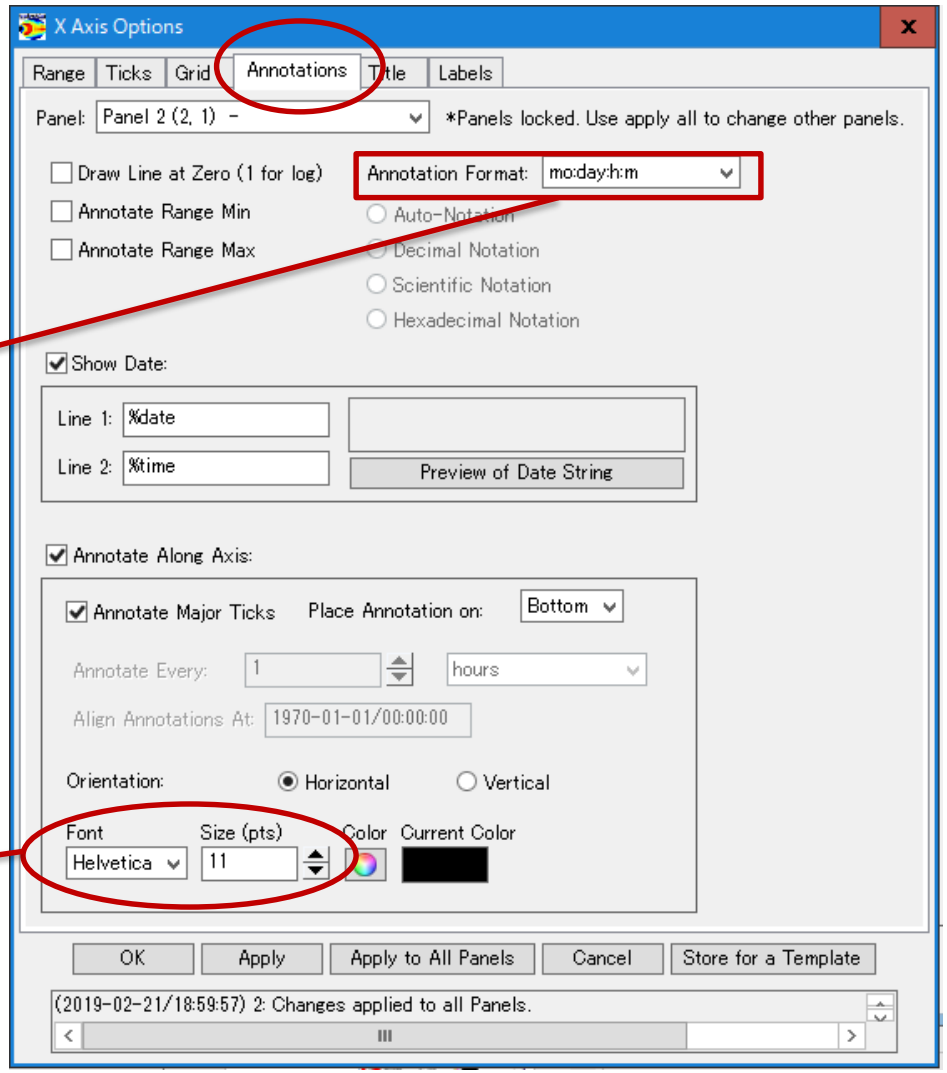
Click Apply to All Panels → OK

If you want to change the character font and size, you select your favored format in the pull-down menu of Font.

Specify the character size from "Size".

Selectable format：

Courier, Helvetica, Times



3.7 Customize the data plot (change x-axis label)

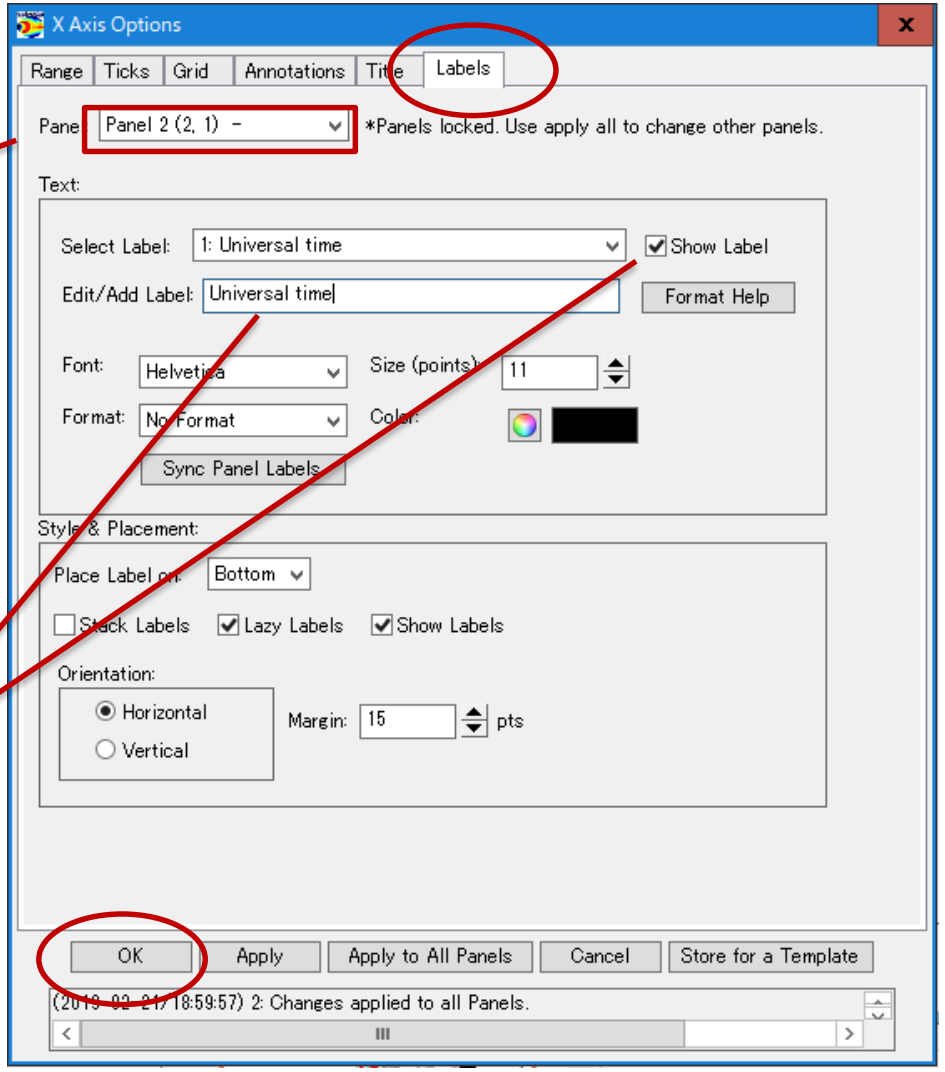
You can customize the time label (X axis) on the Labels tab.

Select “Panel 2” which is the bottom panel.

You enter the check into the “Show Label” box, and enter “Universal Time ” on the Edit/Add Label: .

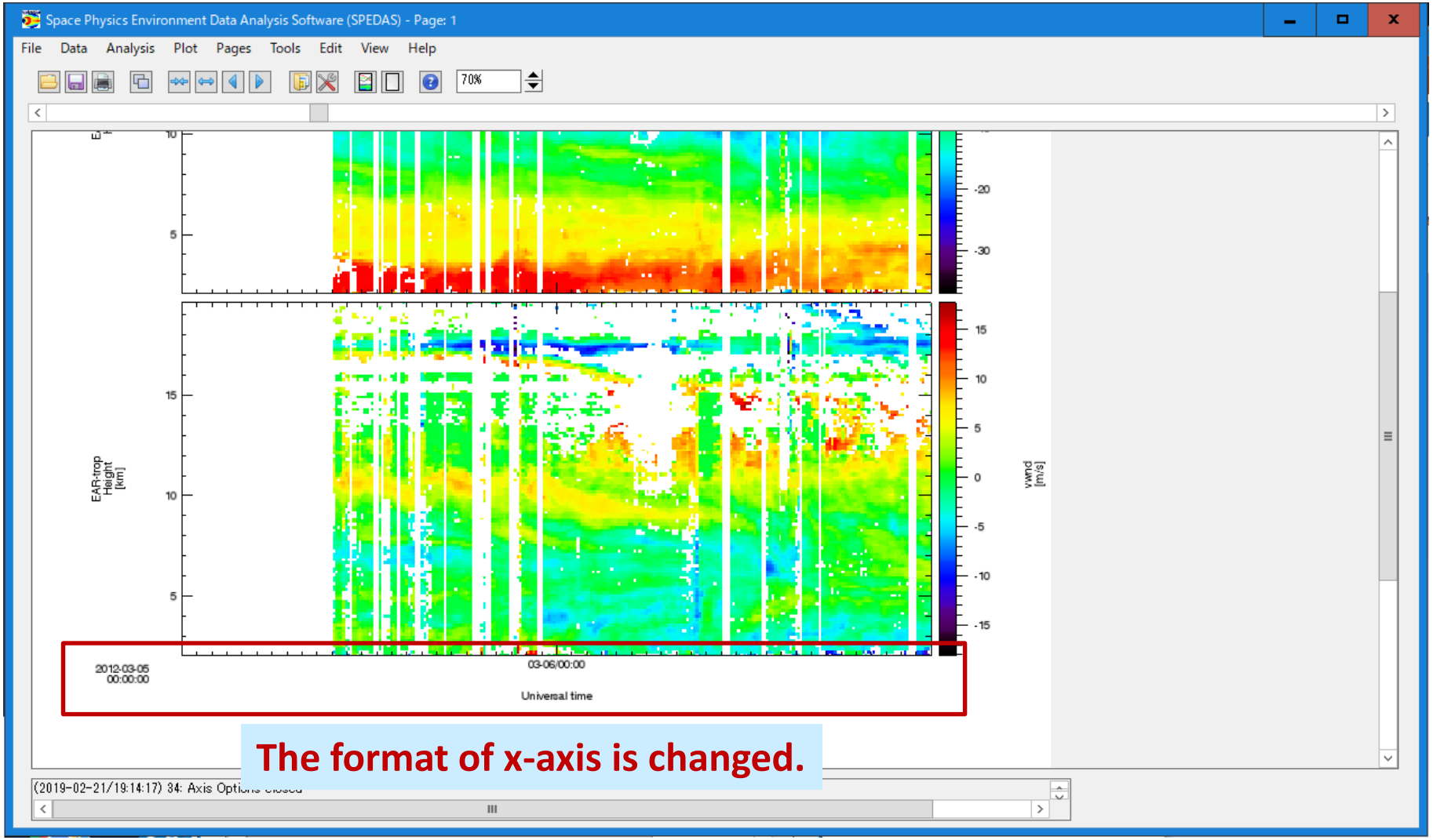
Click OK

(Note that you do not click Apply to All Panels)



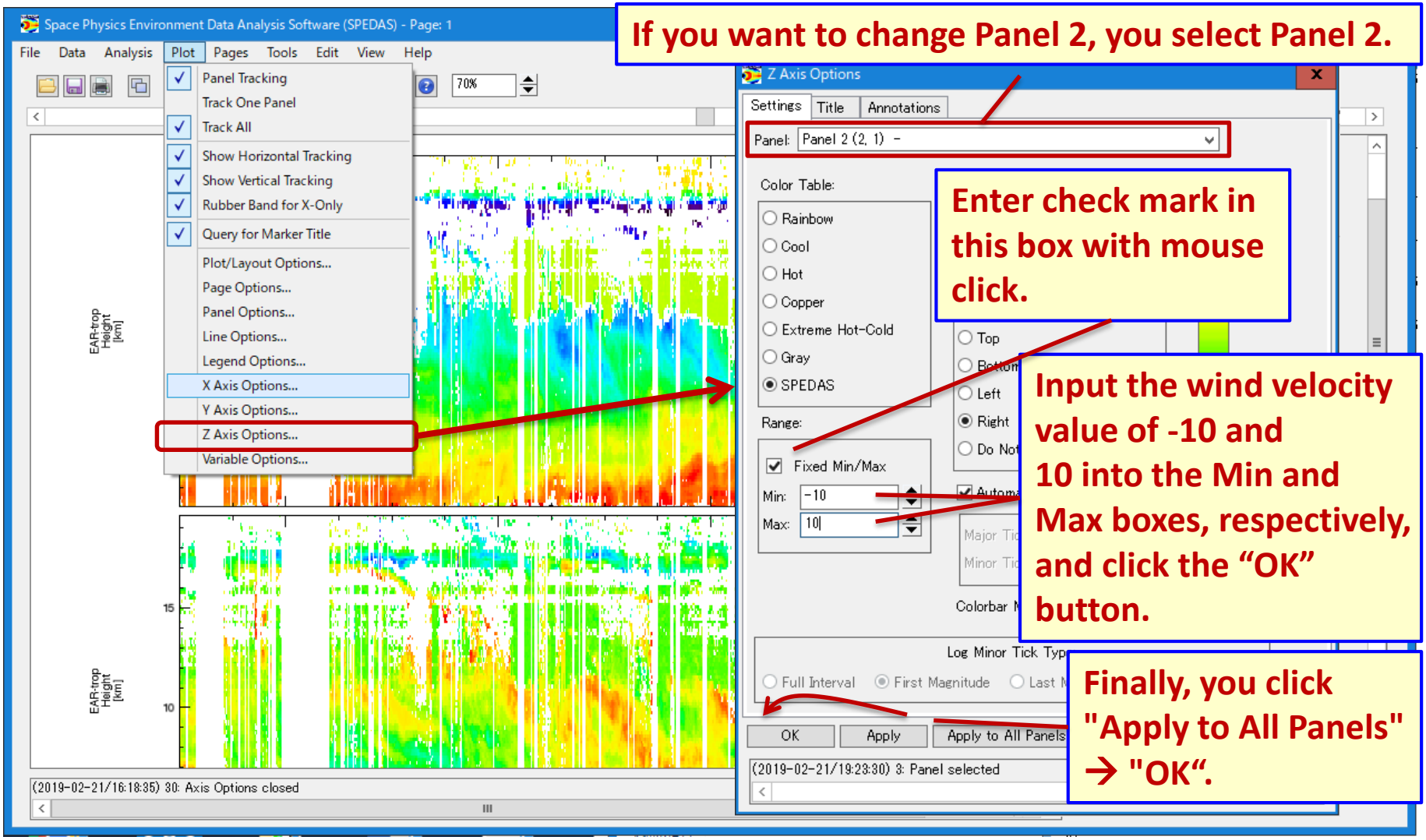
3. How to use SPEDAS

3.7 Customize the data plot (results)



3. How to use SPEDAS

3.7 Customize the data plot (change the color bar format)

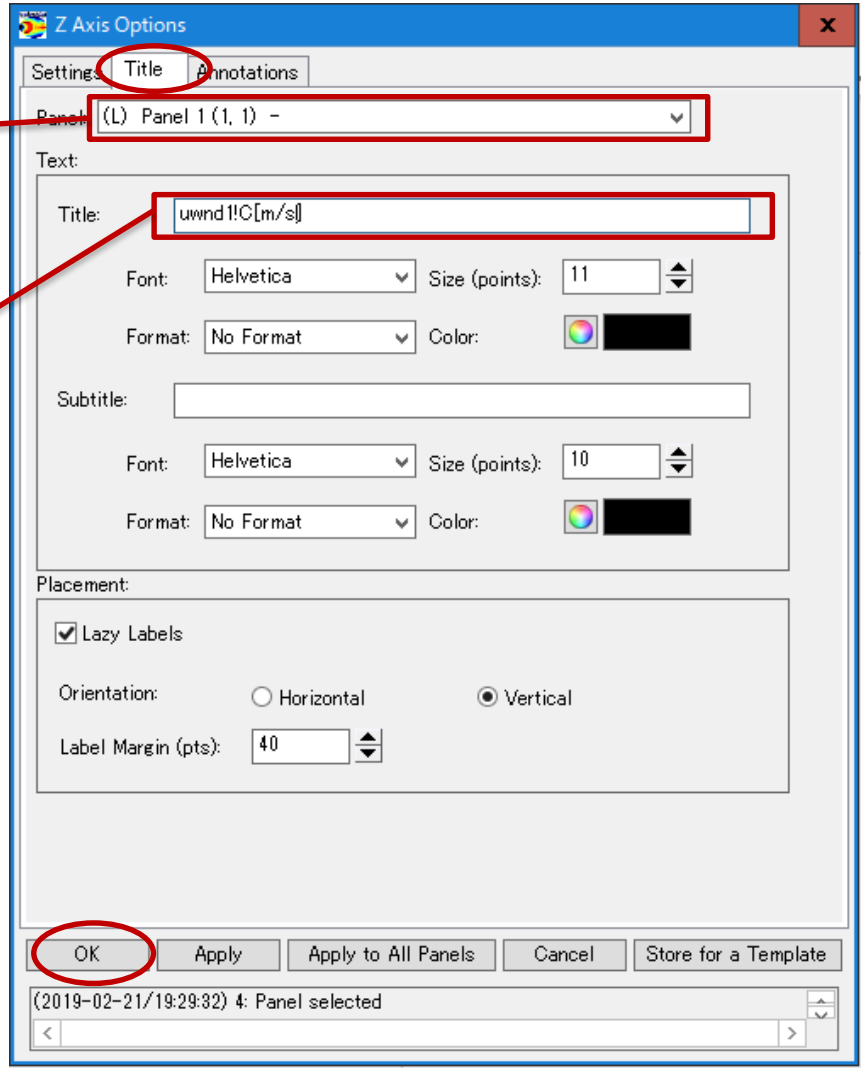


3. How to use SPEDAS

3.7 Customize the data plot (change the color bar format)

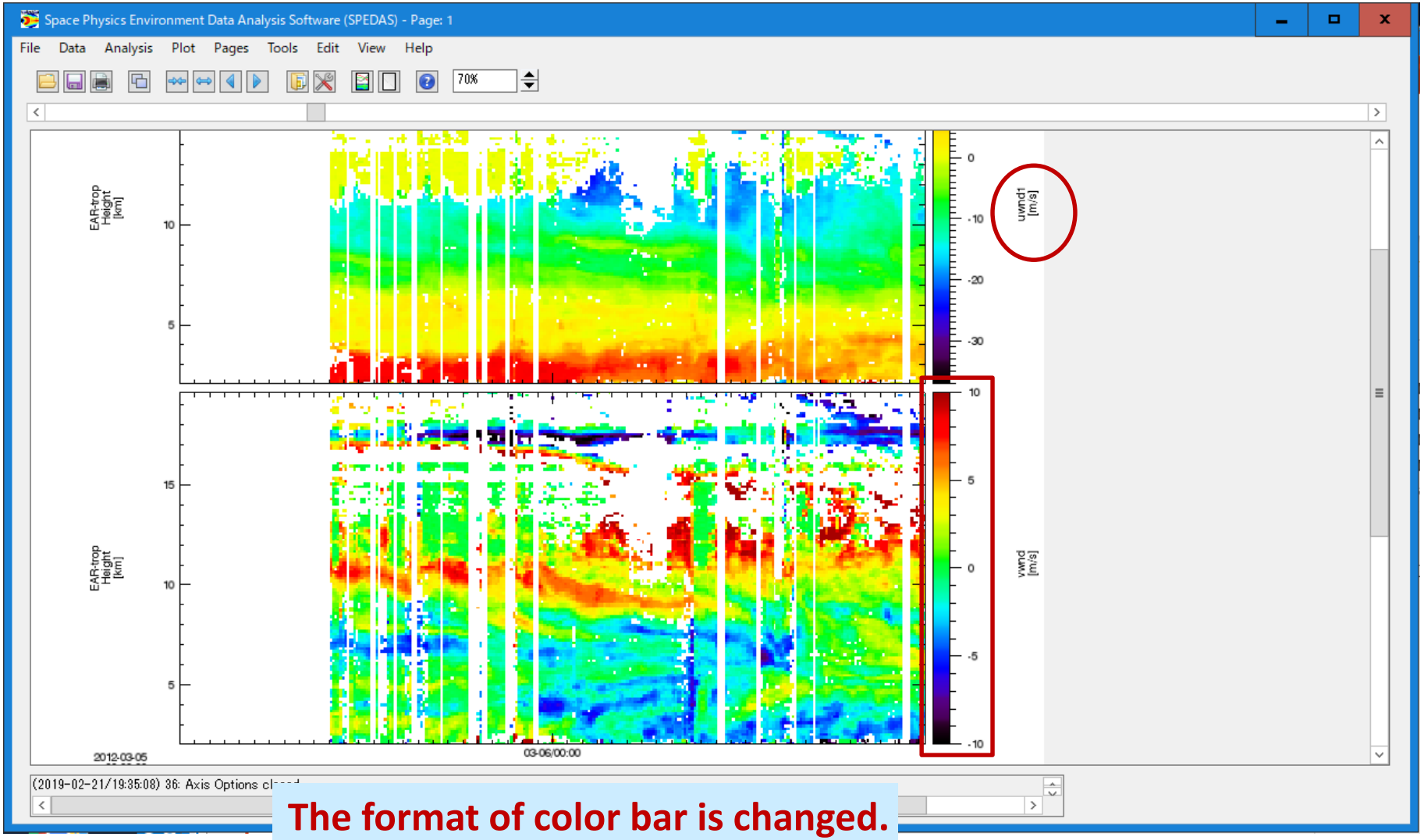
If you want to change Panel 1, you select Panel 1.

Change the title of z-axis “dpl1!C[dB]” into “uwnd!C[m/s]”, and click the “OK” button.



3. How to use SPEDAS

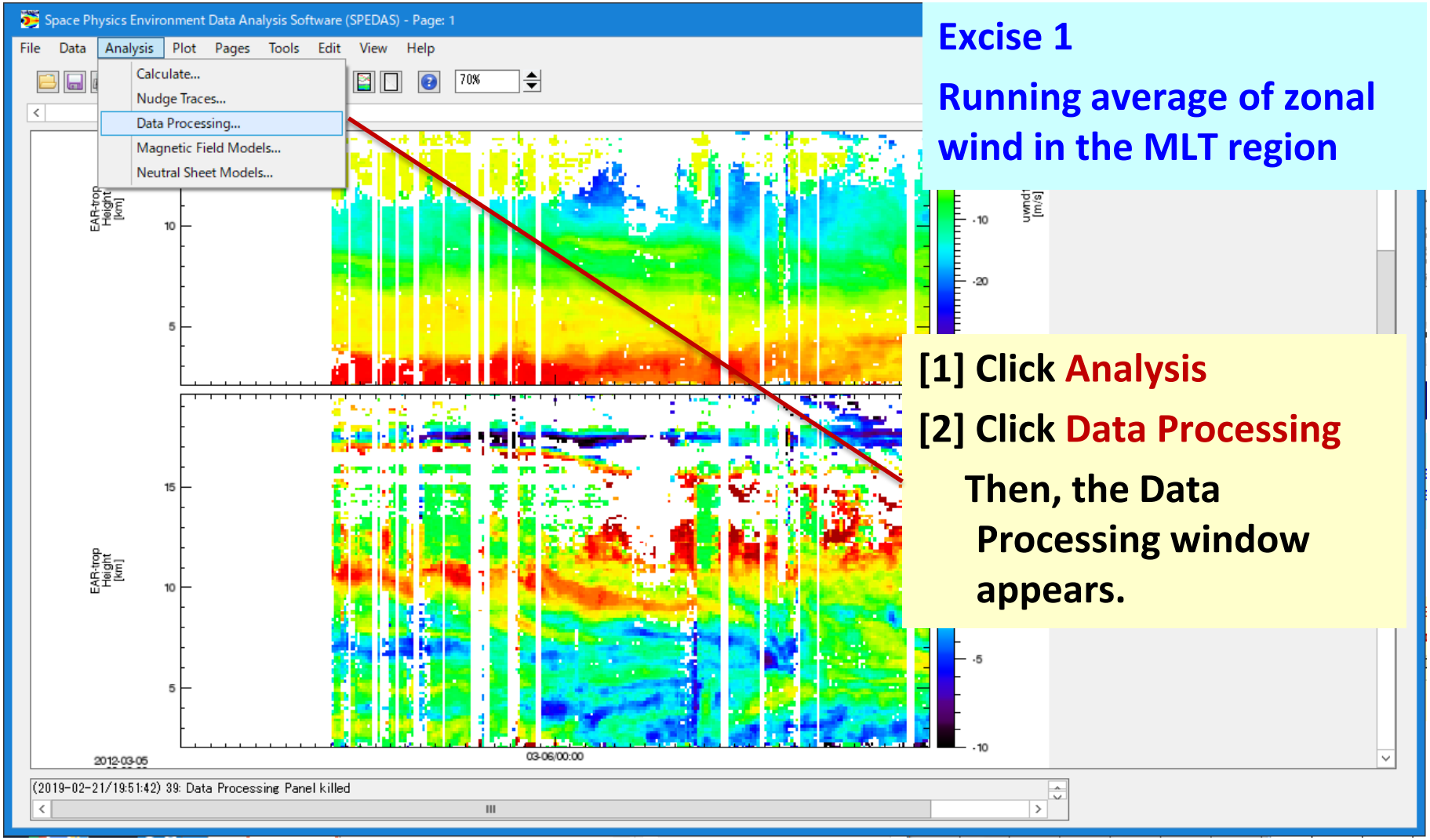
3.7 Customize the data plot (change the color bar format)



The format of color bar is changed.

3. How to use SPEDAS

3.8 Time-series analysis of the EAR data



Excise 1

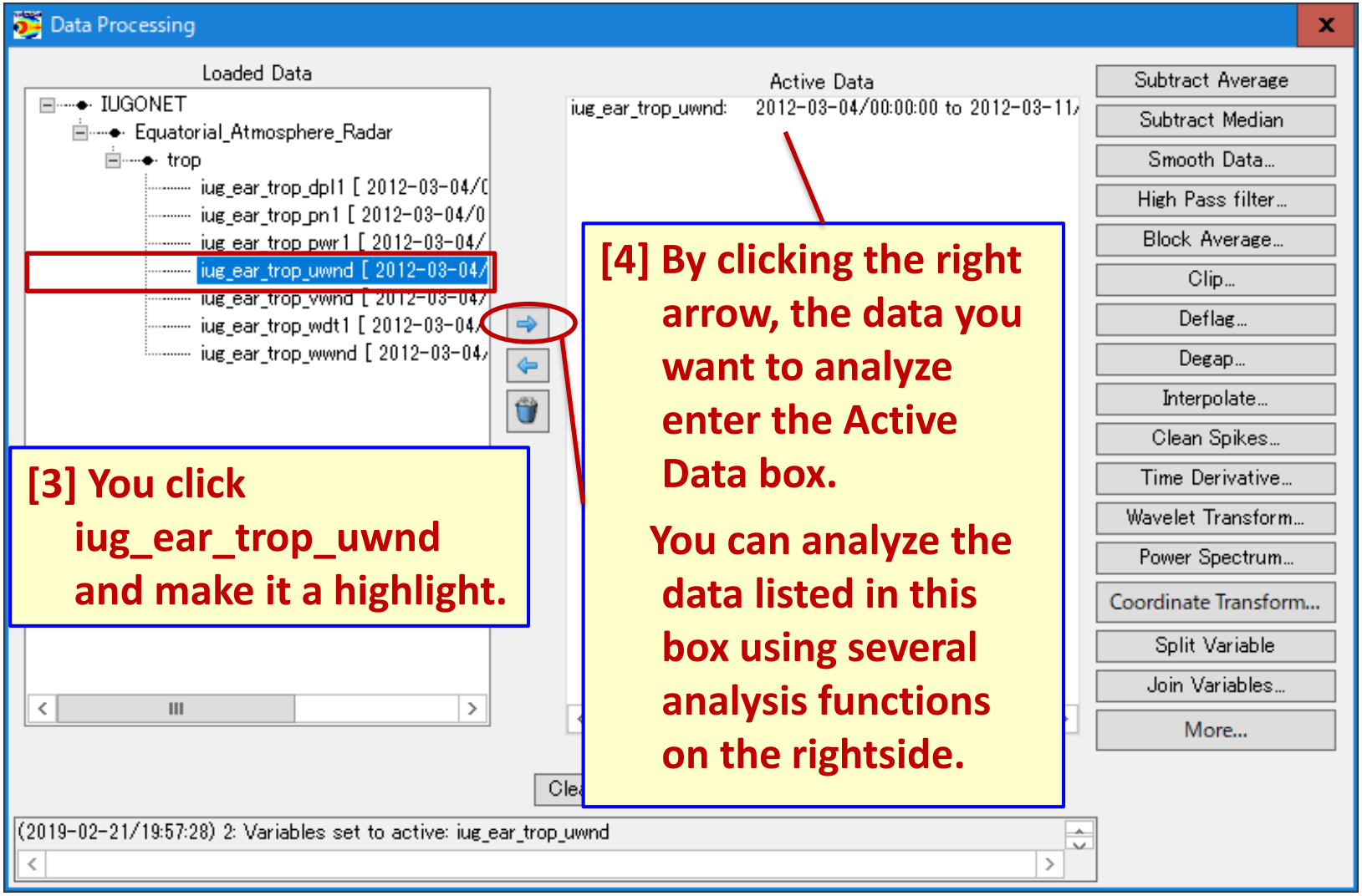
Running average of zonal wind in the MLT region

[1] Click Analysis

[2] Click Data Processing

Then, the Data Processing window appears.

3.8 Time-series analysis of the EAR data



3.8 Time-series analysis of the EAR data

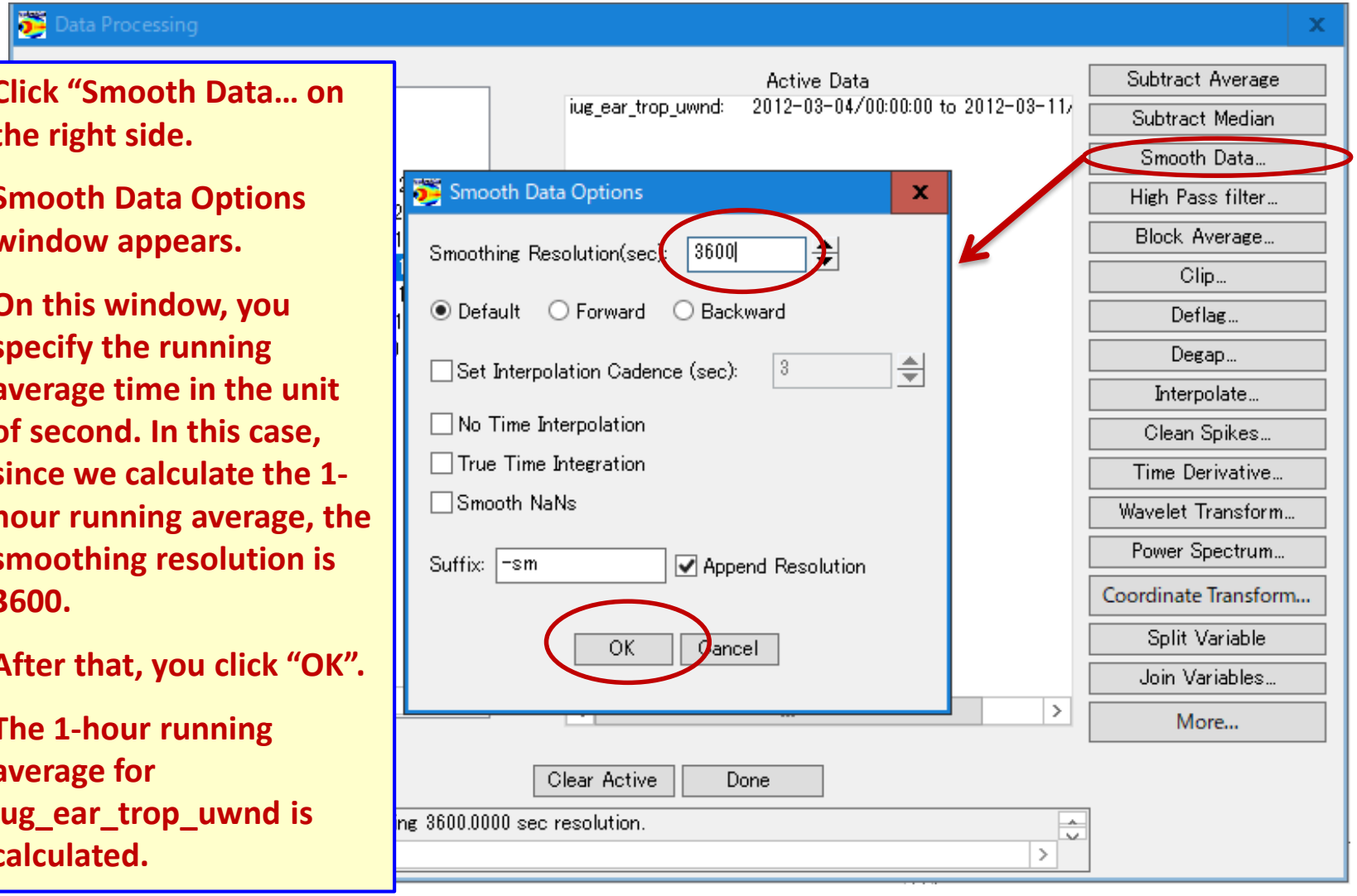
Click “Smooth Data… on the right side.

Smooth Data Options window appears.

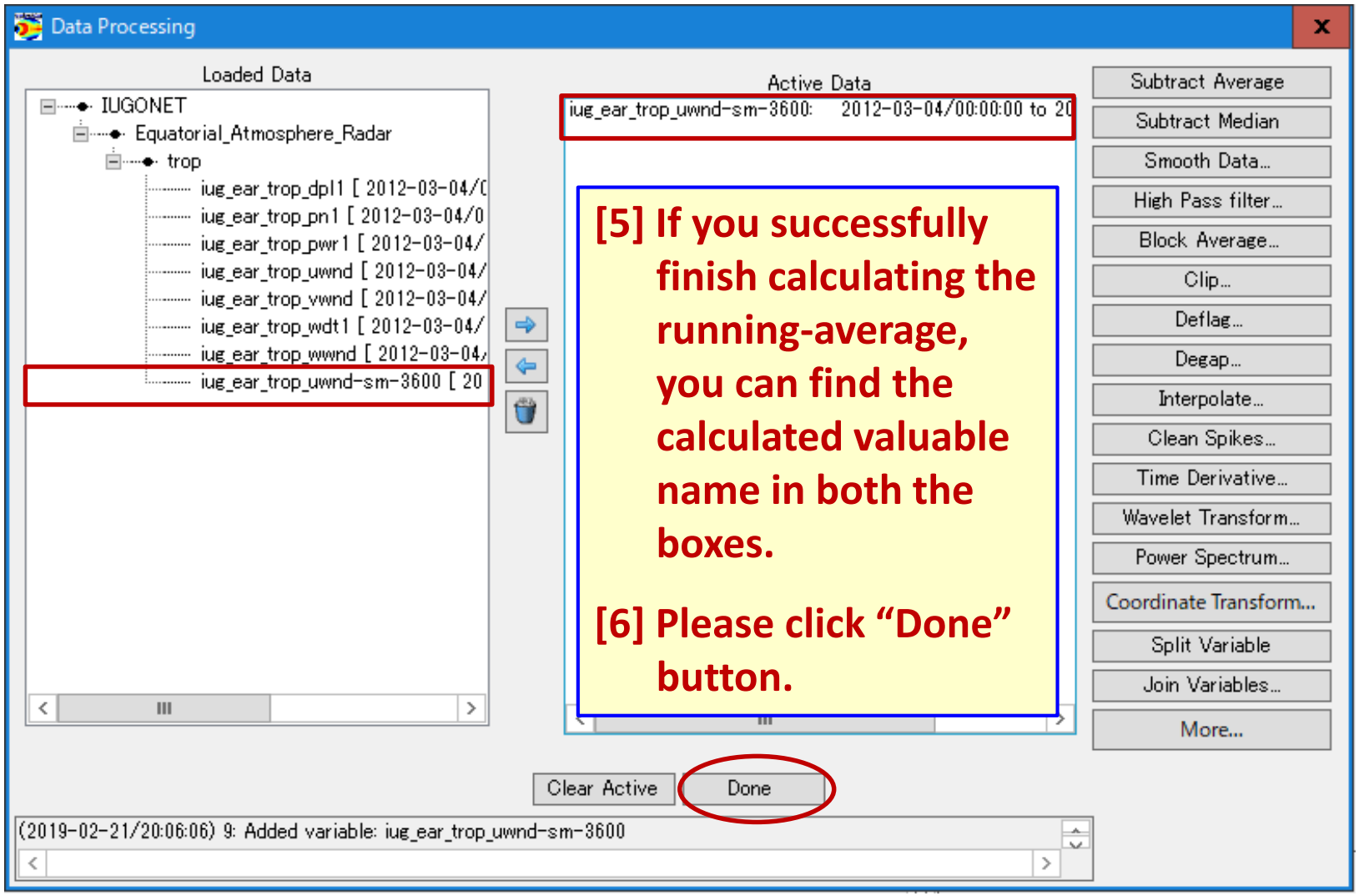
On this window, you specify the running average time in the unit of second. In this case, since we calculate the 1-hour running average, the smoothing resolution is 3600.

After that, you click “OK”.

The 1-hour running average for iug_ear_trop_uwnd is calculated.

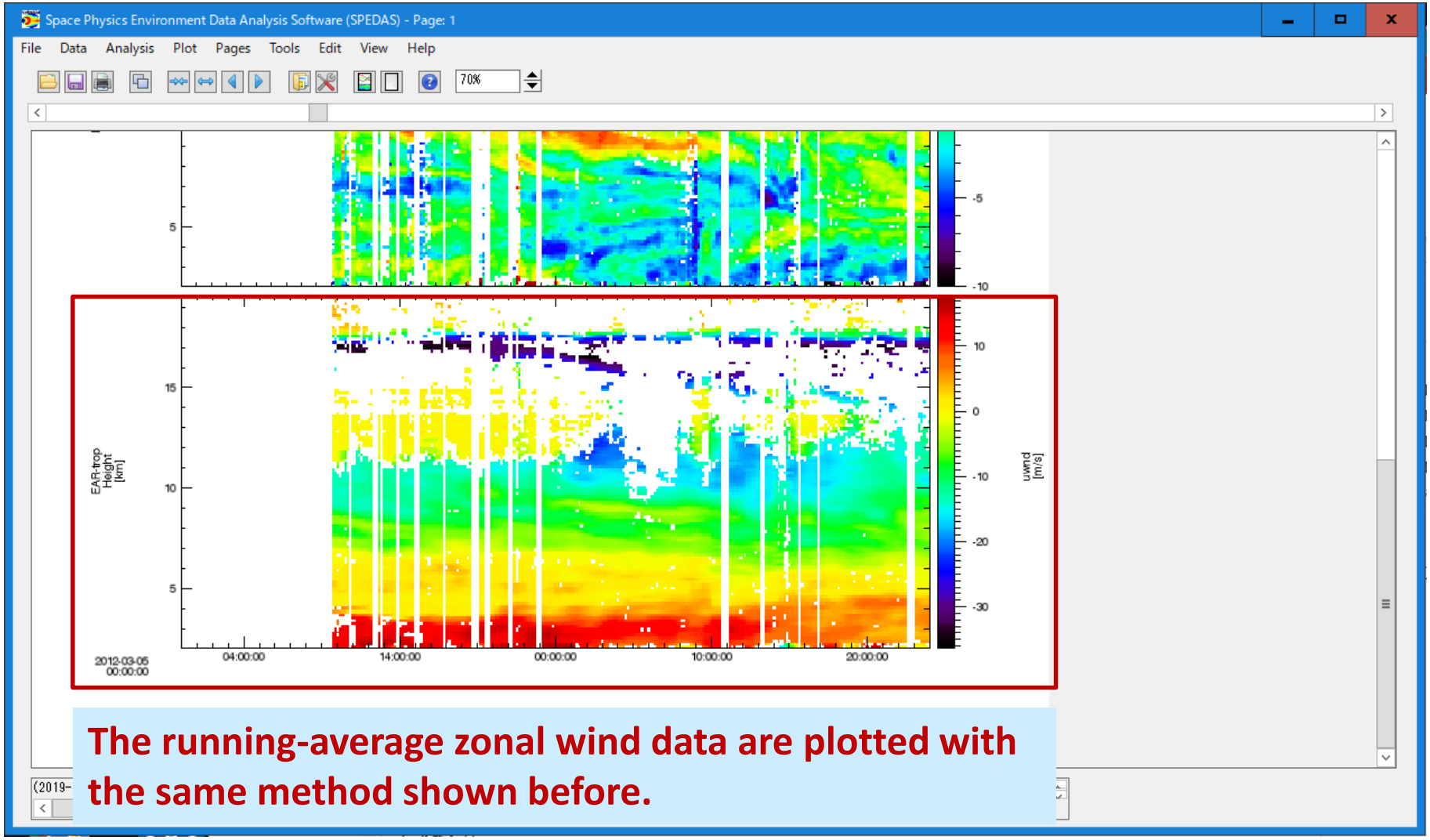


3.8 Time-series analysis of the EAR data



3. How to use SPEDAS

3.8 Time-series analysis of the EAR data



The running-average zonal wind data are plotted with the same method shown before.

3.9 Exercise (3.4～2.8 items)

Let's try SPEDAS

You try to analyze various kinds of ground-based and satellite observation data with SPEDAS.

For example, automatic weather station (AWS), wind profiler radar, EAR, radiosonde etc.

If you have some time, please try to search other datasets (solar, geomagnetic field, ionospheric plasma, air glow etc.)

Time limit: 15 – 20 minutes

If you have any questions and suggestions on this exercise and SPEDAS, please let me know them.

4. Summary and conclusions

- **The IUGONET project (http://www.iugonet.org) has been establishing a IUGONET web service (IUGONET Type-A) which combines a database of data information (metadata) and data analysis software (SPEDAS).**
- **This IUGONET Type-A is useful for researchers in efficiently finding and obtaining various kinds of observation data spread across the IUGONET institutes.**
- **The IUGONET Type-A and integrated data analysis software (UDAS) will significantly facilitate the analyses of a variety of observation data, which will lead to more comprehensive studies of coupling process in solar-terrestrial system (long-term variation in the Earth's atmospheric environment) and interdisciplinary studies using different kinds of data.**
- **The IUGONET products have been released!**

IUGONET Type-A : **http://search.iugonet.org/**

Analysis software : **http://www.iugonet.org/en/software.html**

4. Summary and conclusions

- **In order to enhance an international use of the IUGONET products and data for non IDL users, we have a plan to develop the data analysis software working on other platforms (for example, MATLAB,…).**
- **In near future, we will add several kinds of geoscience data in the web service (IUGONET Type-A).**

  Solar surface (Ca obs.) [NAOJ], GPS-TEC [Nagoya U/NICT]
- **Recently, we developed a UDAS EGG (UDAS Easy Guide to Generate your load routines) to provide users with the templates for IDL procedures that can load their own data into SPEDAS/IDL.**
- **If you have any feedbacks, questions, requests on the IUGONET tool, please send email to the following:**

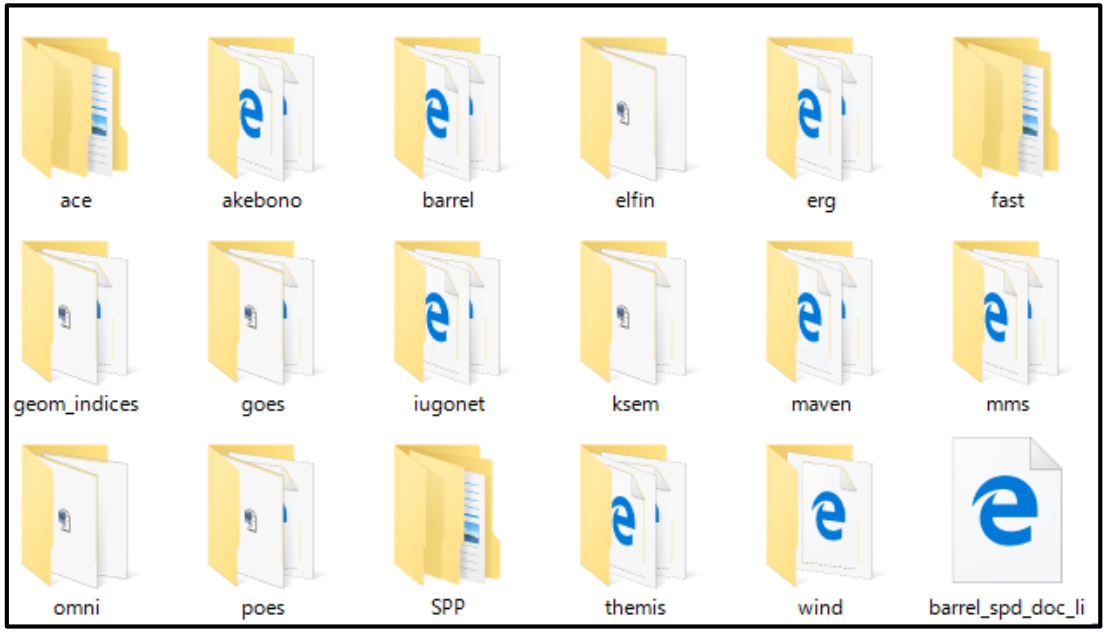
E-mail iugonet-contact(at)iugonet.org

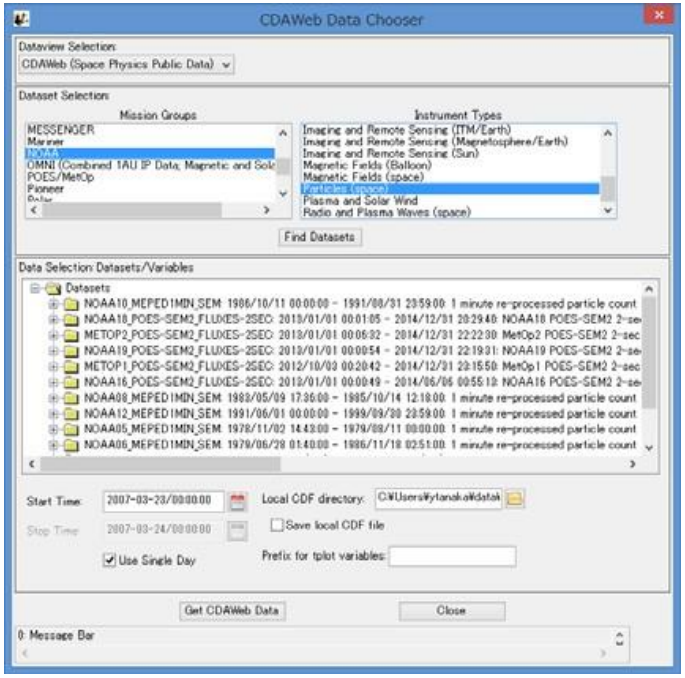
You also check the IUGONET homepage (http://www.iugonet.org)

2. IUGONET data analysis system

2.7 IUGONET data analysis software (UDAS)

< Latest plug-in tools included in SPEDAS >





Plug-in tools stored in a bleeding edge of SPEDAS (2016/10/20)

- ✓ SPEDAS contains various kinds of project plug-in tools (iugonet, erg, ace, akebono, fast, wind etc.)

  ※rbsp and stereo are stored in another directory.
- ✓ We can load and plot various kinds of satellite data which are open in CDAWeb managed by NASA.

2. IUGONET data analysis system

2.7 IUGONET data analysis software (UDAS)

< Load command of UDAS/SPEDAS >

UDAS s1.00.1 (for SPEDAS v1.00)

- **29 kinds of load commands are available.**
- **This package includes the statistical analysis and metadata cooperate tools.**
- **We have a plan to add the load routines of all-sky imager, riometer, VLF, and GPS-RO data to UDAS.**
- **(*) means alias of load command developed in ERG-SC.**

No.	Instrument Type	Load routines
1	Solar images obtained by the SMART telescope	iug_load_smart
2	Solar VHF/UHF radio spectrum	iug_load_iprt
3	Jupiter's/Solar wide band spectral data in HF-band	iug_load_hf_tohokuu
4	Automatic weather station	iug_load_aws_rish
5	Boundary layer radar	iug_load_blr_rish
6	L-band lower troposphere radar	iug_load_ltr_rish
7	EAR (ST and FAI)	iug_load_ear
8	MU radar (MST, IS, Meter/RASS/FAI)	iug_load_mu
9	Meteor radar	iug_load_meteor_rish
10	MF radar	iug_load_mf_rish
11	Wind profiler radar	iug_load_wpr_rish
12	Ionosonde (Shigaraki)	iug_load_ionosonde_rish
13	Radiosonde	iug_load_radiosonde_rish

2. IUGONET data analysis system

2.7 IUGONET data analysis software (UDAS)

No.	Instrument Type	Load routines
14	SuperDARN radar (*)	iug_load_sdfit (*)
15	EISCAT radar	iug_load_eiscat
16	EISCAT radar （ion velocity/electric field）	iug_load_eiscat_vief
17	Imaging riometer at Syowa	iug_load_irio_nipr
18	Low-frequency radio transmitter observation data	iug_load_lfrto
19	Asia VLF Observation Network (AVON/VLF-B)	iug_load_avon_vlfb
20	Optical Mesosphere Thermosphere Imagers (OMTI)	iug_load_camera_omti_asi (*)
21	All sky imager	iug_load_asi_nipr
22	All sky imager keogram	iug_load_ask_nipr
23	Geomagnetic index （AE, Dst, ASY/SYM） and WDC geomagnetic field data	iug_load_gmag_wdc
24	Magnetometer network data at Syowa, Ice land and Anterctica	iug_load_gmag_nipr
25	210 Magnetic Meridian magnetometer network data (*)	iug_load_gmag_mm210 (*)
26	MAGDAS geomagnetic field data	iug_load_gmag_magdas_1sec (*)
27	STEL induction magnetometer data (*)	iug_load_gmag_stel_induction (*)
28	Syowa and Ice land induction magnetometer	iug_load_gmag_nipr_induction
29	Kyushu GCM simulation data	lug_load_kyushugcm

2. IUGONET data analysis system

2.8 Outreach activities of the IUGONET project

In order for many research communities to use the IUGONET data analysis service (IUGONET Type-A and UDAS) as an essential e-infrastructure to investigate long-term variation in the upper atmosphere, an outreach activity is very important.

● Mini- training of how to use the IUGONET MDB system and data analysis software (UDAS)

- 2011/03/27-28 : NARL, India
- 2012/08/27-30 : LAPAN, Bandung, Indonesia
- 2013/01/12 : Online lecture (RISH-LAPAN)
- 2013/02/11 : Online lecture (RISH-LAPAN)
- 2014/11/13-15 : SPL/NARL, India
- 2015/10/21-22 : LAPAN, Bandung, Indonesia

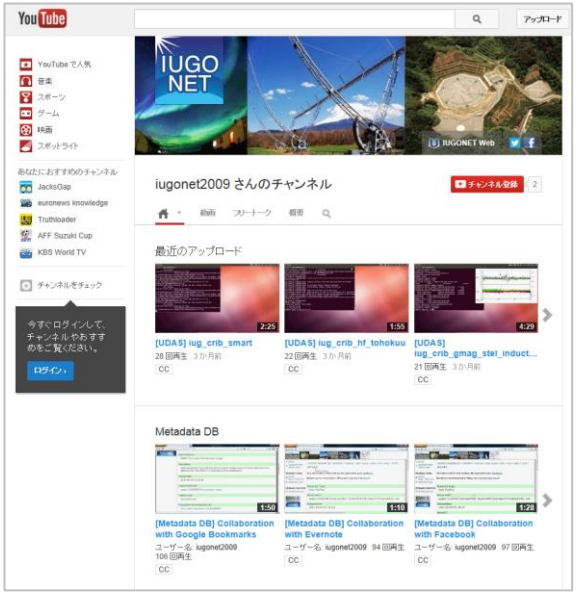
Mini-training of the IUGONET data analysis at LAPAN on Oct. 21-22, 2015

2. IUGONET data analysis system

2.8 Outreach activities of the IUGONET project

● **Online tutorial movies**

Researchers can learn how to use IUGONET MDB and data analysis software anytime online at the IUGONET's YouTube site.



http://www.youtube.com/user/iugonet2009

● **Updating Web page**

http://www.iugonet.org/en/index.html

● **IUGONET mailing list**

http://www.iugonet.org/en/mailinglist.html

Users registered to the IUGONET mailing list can get all the latest IUGONET-related information about new releases of UDAS and IUGONET data analysis service, workshops, and so on.

● **IUGONET pamphlet**

http://www.iugonet.org/doc/iugonet2015e_A4.pdf

2. IUGONET data analysis system

2.10 Example of upper atmospheric researches

We are promoting several scientific researches in order to evaluate the IUGONET products and to introduce a good example of application of solar-terrestrial physics researches.

- Evaluation of the IUGONET products
  - To modify interface, and to add new functions to the IUGONET system.
- Examples of application of solar-terrestrial physics researches
  - To acquire researchers to use the IUGONET data analysis system for long-term variation in solar-terrestrial physics.

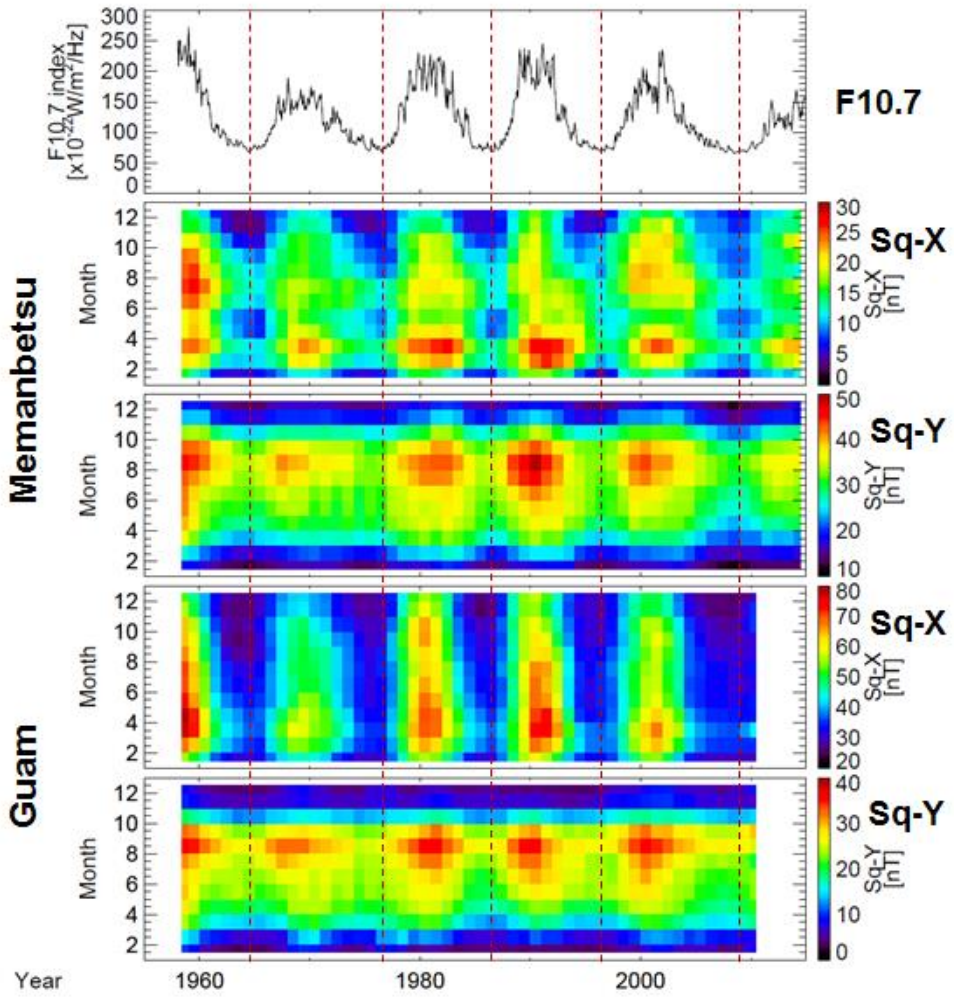
【Examples of upper atmospheric researches using the IUGONET products】

- Influence of solar EUV radiation on upper atmosphere based on solar image data analysis [Kyoto and Nagoya Univ.]
- Long-term variation of upper atmosphere as seen in the geomagnetic solar quiet daily variation [Kyoto and Nagoya Univ.]
- Geomagnetic field variation and ionospheric disturbance dynamo during geomagnetic storms [Kyoto and Nagoya Univ., NIPR]
- Long-term variation in the MLT winds and wave activity [Student education, Kyoto Univ.]

2. IUGONET data analysis system

2.10 Example of upper atmospheric researches

Long-term variation in the amplitude of geomagnetic field variation



- **Using the IUGONET data analysis system, we can easily handle the long-term observation data.**
- **In this case, the size of geomagnetic field variation depends on solar activity.**