



IUGONET

Metadata DB for Upper Atmosphere

超高層大気長期変動の全球地上ネットワーク観測・研究
Inter-university Upper atmosphere Global Observation NETwork

Development of integrated analysis software of observation data in the upper atmosphere

¹Atsuki Shinbori, ²Yoshimasa Tanaka, ³Masato Kagitani and

¹Hiroo Hayashi, ¹RISH, Kyoto University, Uji, Japan

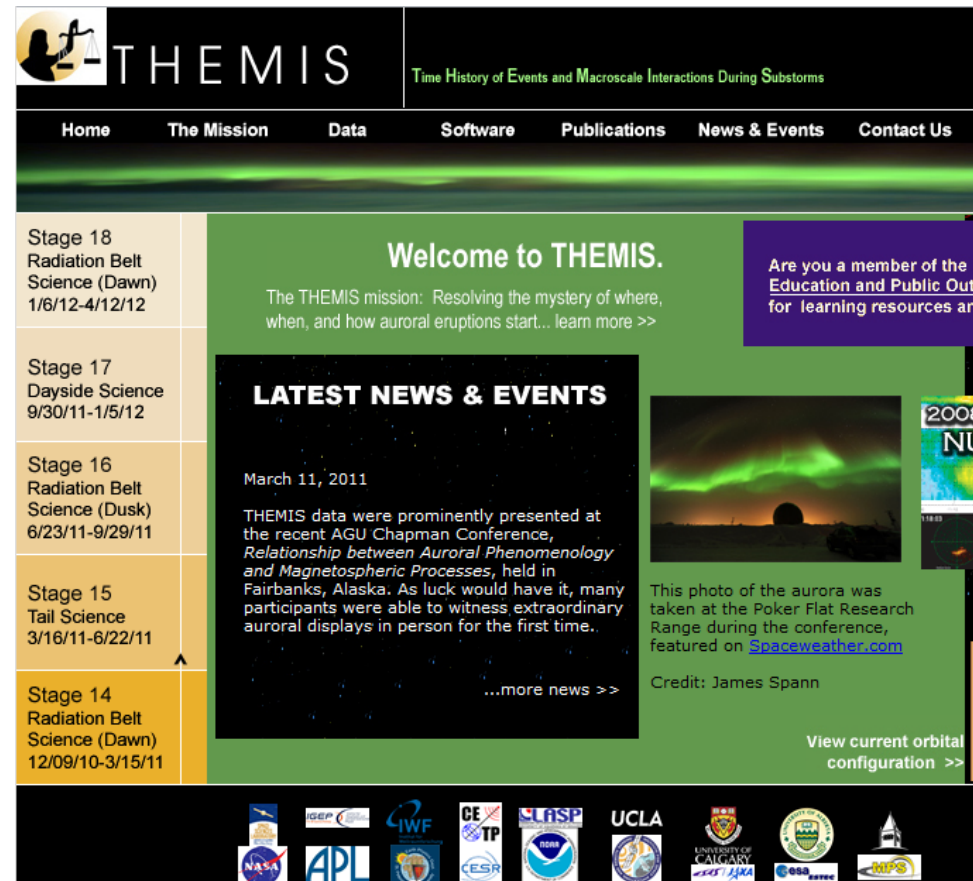
²NIPR, Tachikawa, Japan

³PPARC, Tohoku Univ., Sendai, Japan

1. Overview of the analysis software which has been developed in the IUGONET project
 - ✓ Characteristics of **TDAS** (**T**hemis **D**ata **A**nalysis **S**oftware suite)
 - ✓ Introduce of **UDAS** (**I**Ugonet **D**ata **A**nalysis **S**oftware) in the beta version
2. Demonstration of the UDAS software
3. Future plan and schedule of development of the UDAS software

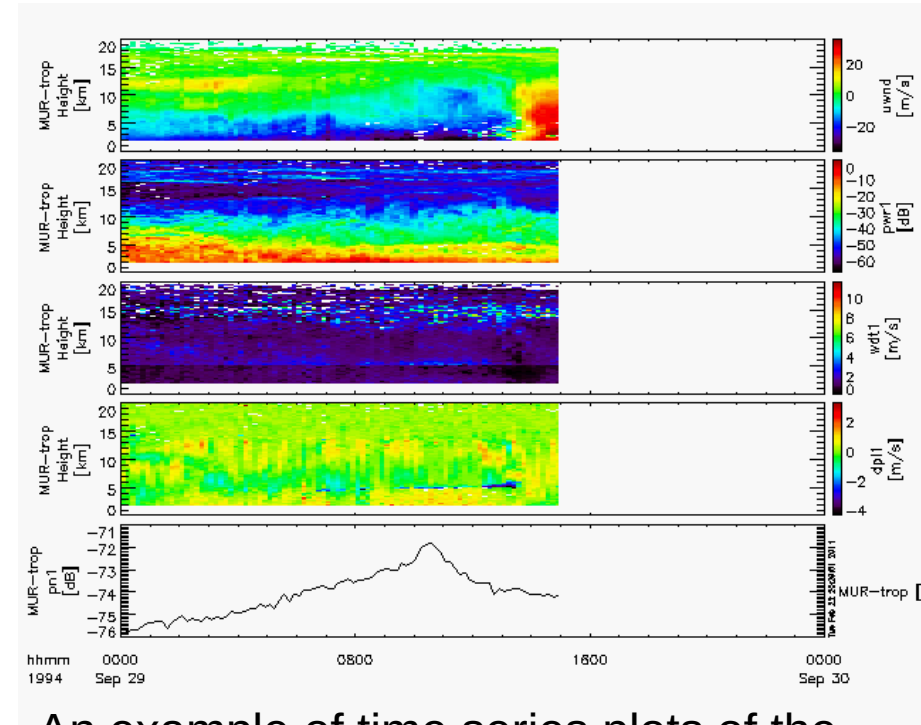
2.1 TDAS (THEMIS Data Analysis Software suite)

1. The IUGONET project will provide software to analyze and visualize various kinds of ground-based observational data in our project.
2. We are developing the data analysis software **on the basis of TDAS** (Themis Data Analysis Software suite).
3. Everybody can freely download the TDAS software from the THEMIS homepage.



2.2 Characteristics of the TDAS software-1

1. The data analysis software is written in IDL (Interactive Data Language), **which is widely used in fields of solar and terrestrial physics.**
2. The IDL routines of TDAS enable **users to easily plot and analyze various kinds of time series observation data.**
3. TDAS is adopted as data analysis software of the ERG (Energization and Radiation in Geospace) mission. Our software development is conducted in collaboration with the ERG Science Center.



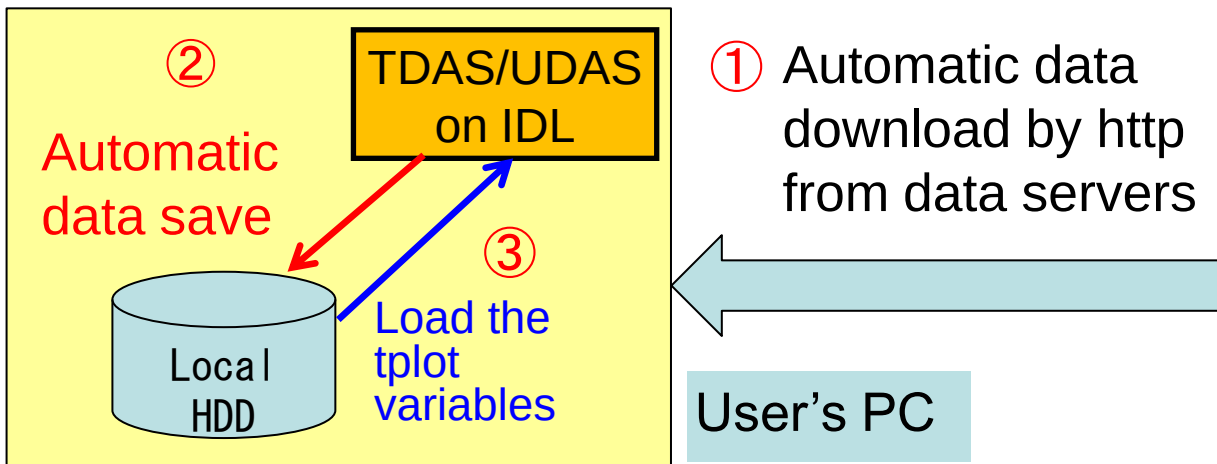
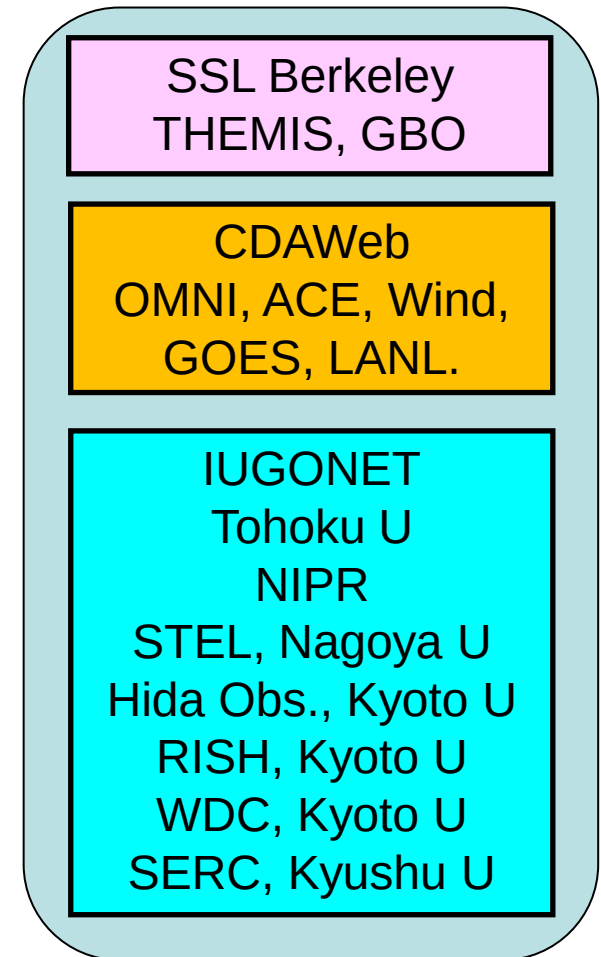
An example of time series plots of the MU radar observation data

2.3 Characteristics of the TDAS software-2

Users can easily download the observation data from data servers and make time series plots with only 3 commands.

```
> timespan, 'yyyy-mm-dd', 13, /day
> thm_load_0000
> tplot, ΔΔΔ
```

Data server



Users can get and analyze various kinds of observation data without any concerns about data locations.

2.3 Characteristics of the TDAS software-3

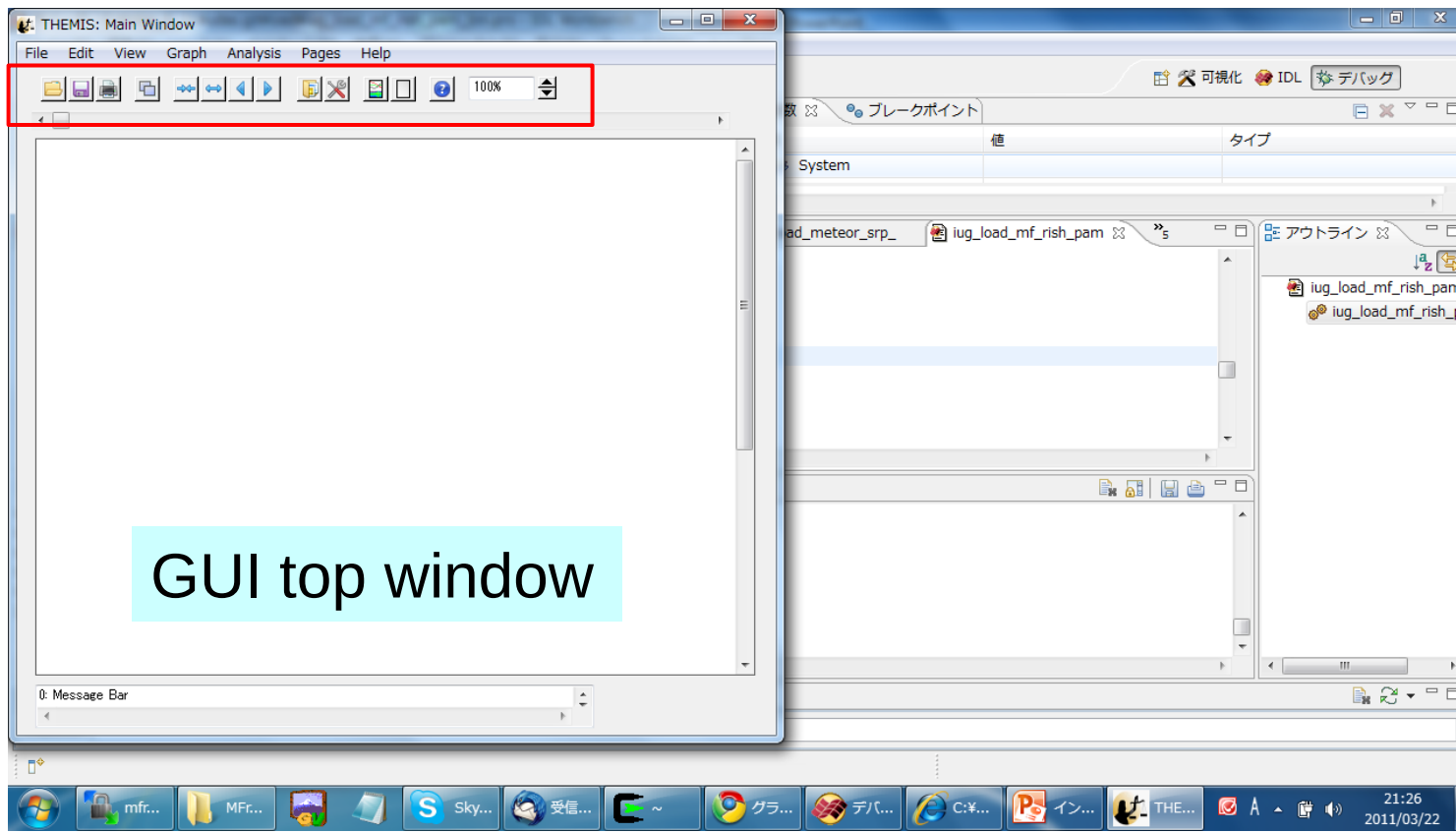
TDAS has many useful routines to visualize and analyze time series data.

By using the TDAS software, everybody can easily

1. **Make several time-series plots of many kinds of observation data in different fields over a long period.**
2. Change the vertical and horizontal axes of the plots.
3. **Calculate time derivative and low or high pass filtered data**
4. Display dynamic spectra of solar radio waves and geomagnetic field pulsation)
6. Plot the kerograms for aurora and optical image data
7. **Make time-height contour plots for three dimensional data**
(Neutral wind, echo power of refractive waves etc.)

2.4 Characteristics of the TDAS software-4

TDAS has the work of Graphical User Interface (GUI) for beginner IDL users. In the GUI mode, you can easily analyze and visualize various kinds of observation data **with only the mouse clicks and key code enter.**



2.5 Load procedures of the UDAS in beta version

1. Load procedures of observation data related to the ERG project:

- `erg_load_gmag_mm210` ; 210° geomagnetic data (Nagoya, Kyushu, NICT, Tohoku)
- `erg_load_gmag_nipr` ; geomagnetic data at Syowa , Ice Land (NIPR)

2. Load procedures of the observation data provided from the IUGONET project:

- `iug_load_blr_rish_txt` ; BLR(RISH, Kyoto)
- `iug_load_ltr_rish_txt` ; L-band LTR (RISH, Kyoto)
- `iug_load_ear` ; Equatorial Atmosphere Radar (EAR) (RISH, Kyoto)
- `iug_load_gmag_serc` ; MAGDAS geomagnetic data (Kyushu)
- `iug_load_gmag_wdc` ; AE, Dst, Sym, Asym induces, geomagnetic data (WDC, Kyoto)
- `iug_load_iprt` ; IPRT (Tohoku)
- `iug_load_mu` ; Middle and Upper (MU) atmosphere radar (RISH, Kyoto)
- `iug_load_meteor_rish` ; Meteor wind radar(RISH, Kyoto)
- `iug_load_mf_rish` ; MF radar (RISH, Kyoto)
- `iug_load_gmag_mm210` ; Elias of `erg_load_gmag_mm210`
- `iug_load_gmag_nipr` ; Elias of `erg_load_gmag_nipr`

3. Load procedures of other data provided in the future :

- `erg_load_sdfit` ; SuperDARN (Nagoya, NIPR, NICT)
- `erg_load_eiscat` ; EISCAT(Nagoya, NIPR)

3. RISH database of MW and MF radars

3.1 Regional network in Indonesia (MW and MF radars)

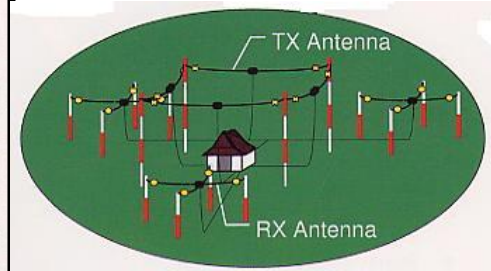
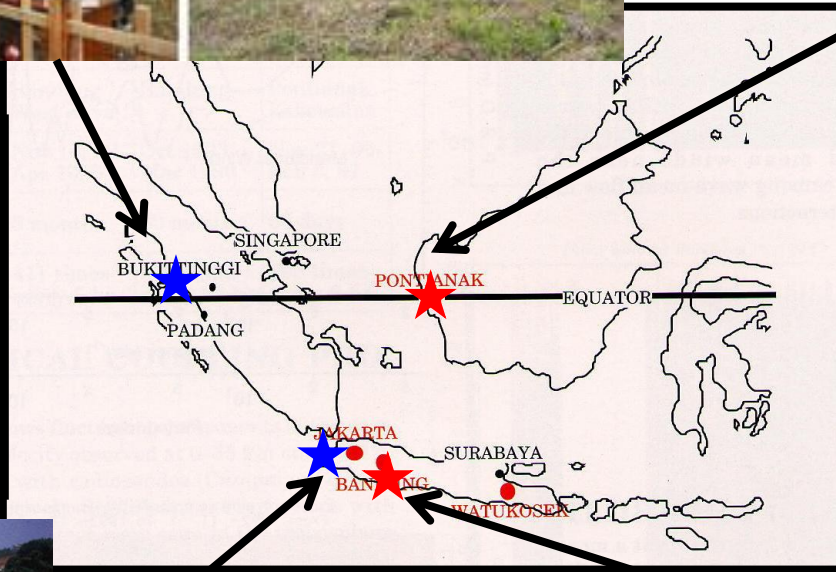


**Meteor radar
Kototabang (2002-)**



**MF radar
Pontianak (1995-)**

**Regional network in
Indonesia (1992-)**
Meteor wind radar
(Jakarta, Kototabang)
MF radar
(Pontianak,
Pameungpeuk)



**Meteor radar
Jakarta (1992-1999)**



**MF radar
Pameungpeuk (2004-)**

3.2 MF and MW radar database

1. Meteor wind radar (Kototabang, Serpong)

<http://database.rish.kyoto-u.ac.jp/arch/iugonet/data/mwr/>

Numerical data: Serpong (1992/10-1999/08)

Kototabang (2002/11 ~ present)

(1) Wind data ⇒ Format: text, NetCDF

Time resolution: 1 hour

(2) Original data (Kototabang)

⇒ Format: text (mp****.mpd)

The original data include the radial Doppler velocity, azimuth and zenith angles etc. for each meteor event.

※ Users can get these numerical data from the metadata search site.
However, they can download and analyze only the wind data using the UDAS software.

3.2 MF and MW radar database

2. MF radar (Pameungpeuk)

<http://database.rish.kyoto-u.ac.jp/arch/iugonet/data/mf/>

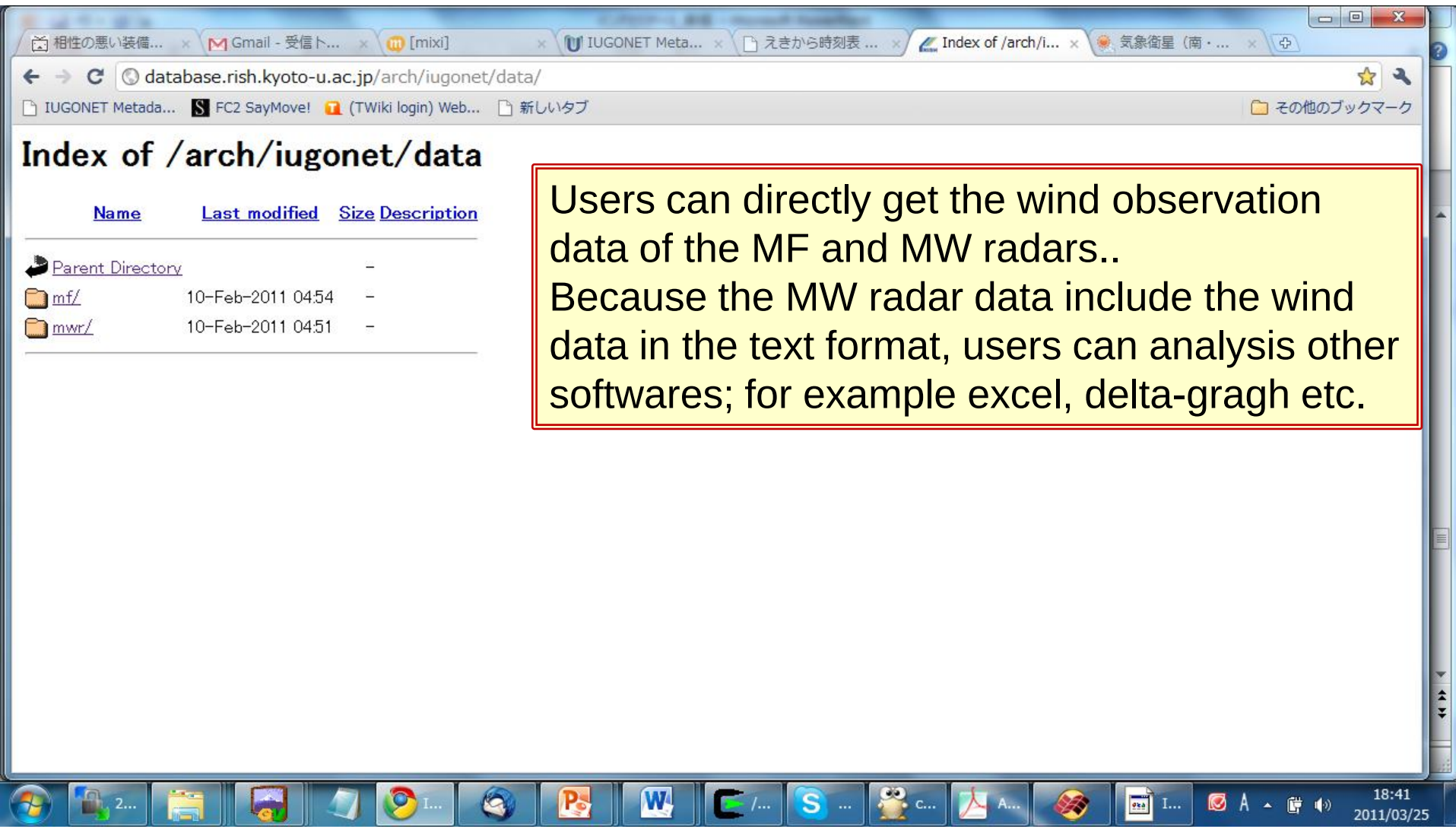
Numerical data: Pameungpeuk (2004/03～present)

Format: Binary, NetCDF

Time resolution: 104 seconds

- ✂ The NetCDF data include only the three components of wind data in the MLT region (52-122 km), while the binary data include all the data set of radar status and wind observation data.
- ✂ Users can get these numerical data from the metadata search system and UDAS software. Users can easily analyze and visualize the wind data obtained at the Pameungpeuk site.

3.3 MF and MW radar database Homepage



database.rish.kyoto-u.ac.jp/arch/iugonet/data/

Index of /arch/iugonet/data

Name	Last modified	Size	Description
Parent Directory	-	-	-
mf/	10-Feb-2011 04:54	-	-
mwr/	10-Feb-2011 04:51	-	-

Users can directly get the wind observation data of the MF and MW radars..
Because the MW radar data include the wind data in the text format, users can analysis other softwares; for example excel, delta-gragh etc.

4.1 Analysis and plot of the observation data in the CUI mode

(ex.) Plot of the wind data obtained from the Kototabang MWR

Start of IDL $\Rightarrow$ enter "thm_init" on the IDL command line

```
> timespan, '2003-10-01', 31, /day (One month from October 1, 2003)
```

```
> iug_load_meteor_rish_nc, site = 'ktb', parameter = 'h2t60min00'
```

```
> tplot_names (Confirmation of the tplot variable names)
```

```
> tplot, 'tplot variable names'
```

$\Rightarrow$ A time series plot is displayed in the other window.

※ Multiple plots :

```
> tplot, ['tplot1', 'tplot2', ...]
```

```
> ylim, 'tplot variable names', (lower), (upper) [Height range]
```

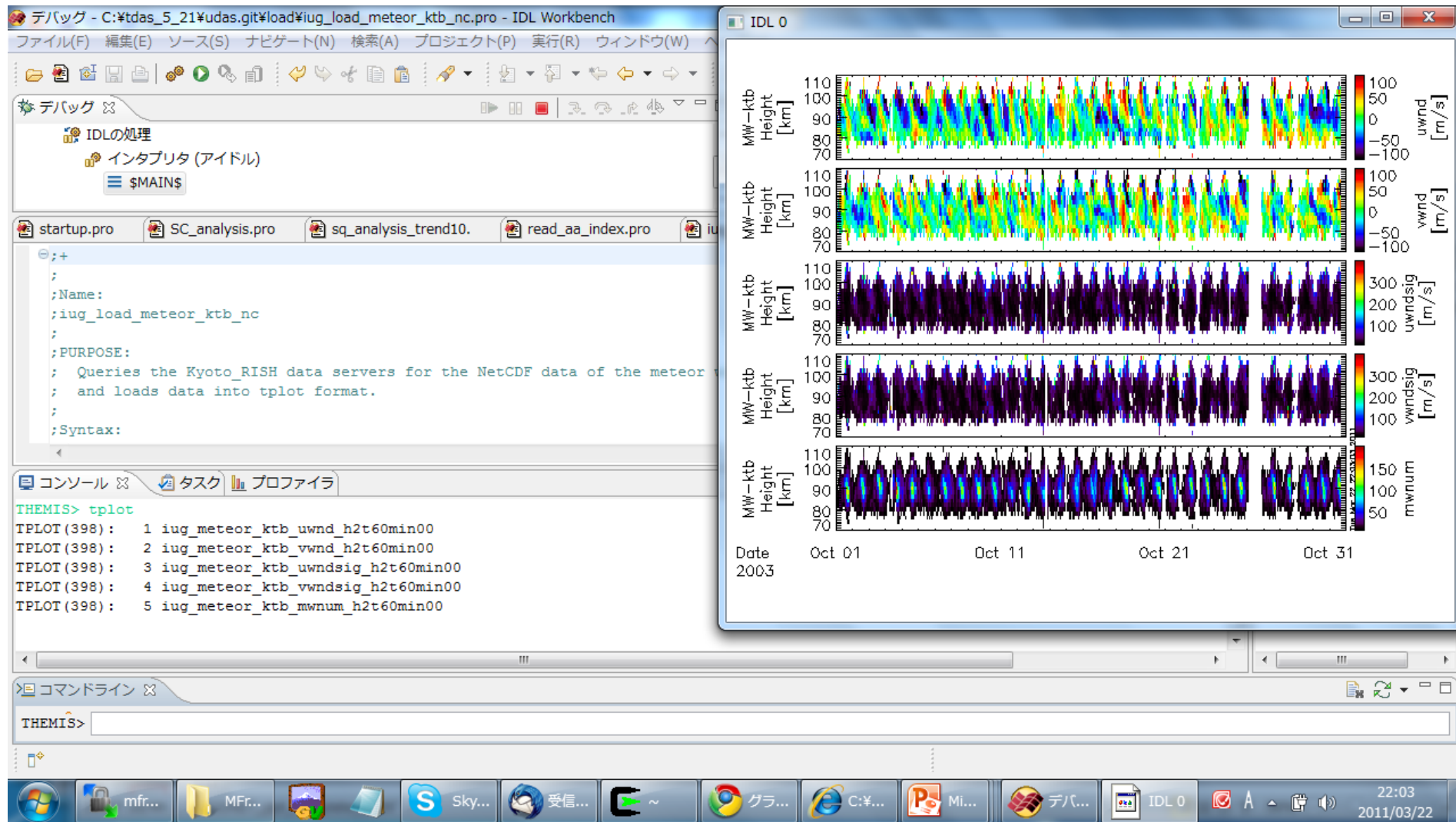
```
> zlim, 'tplot variable names', (lower), (upper) [color bar range]
```

```
> tlimit, 'tplot variable names', '2003-10-01', '2003-10-15' [time range]
```

4. Demonstration of the UDAS software

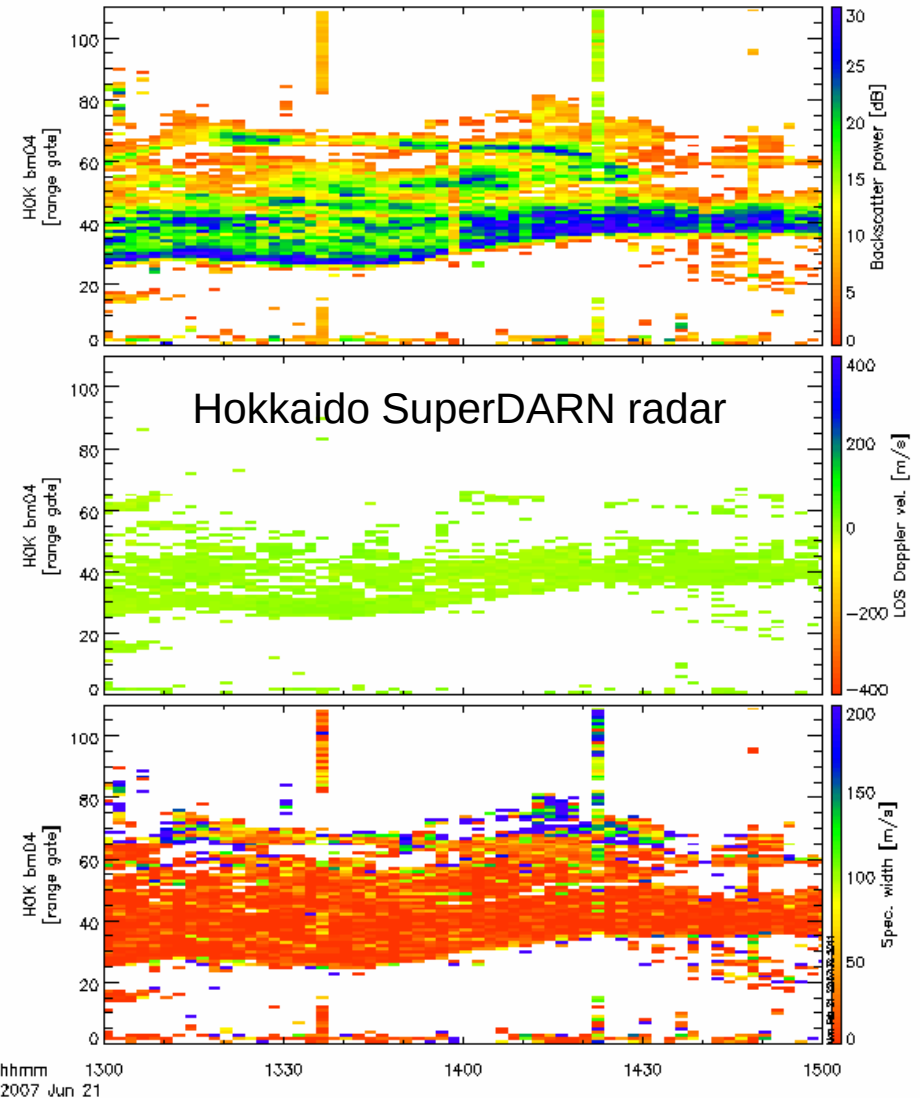
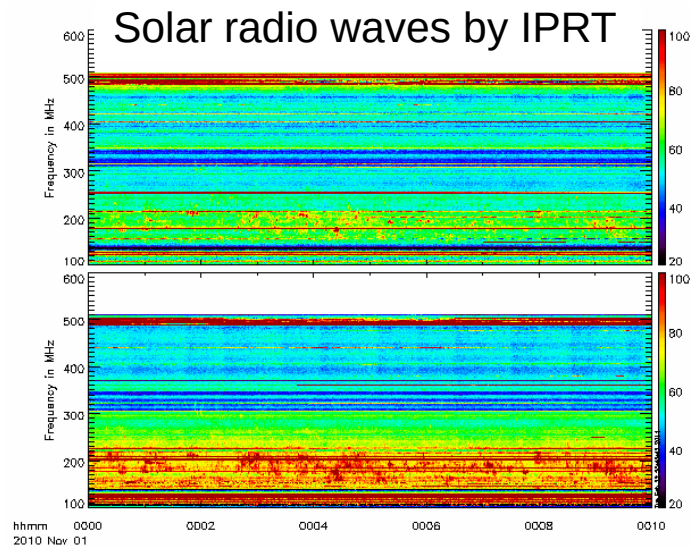
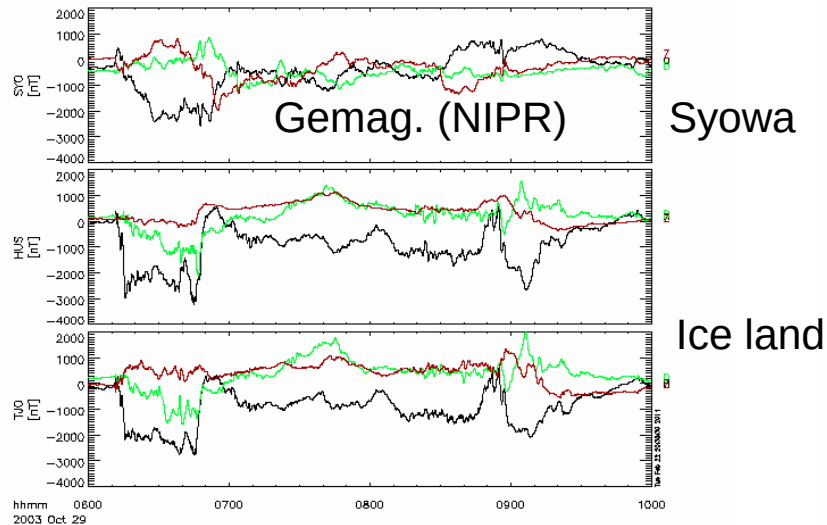
4.1 Analysis and plot of the observation data in the CUI mode

Output of time series plots of several parameters of the wind data



4. Demonstration of the UDAS software

4.2 Examples of time series plots made in the CUI mode



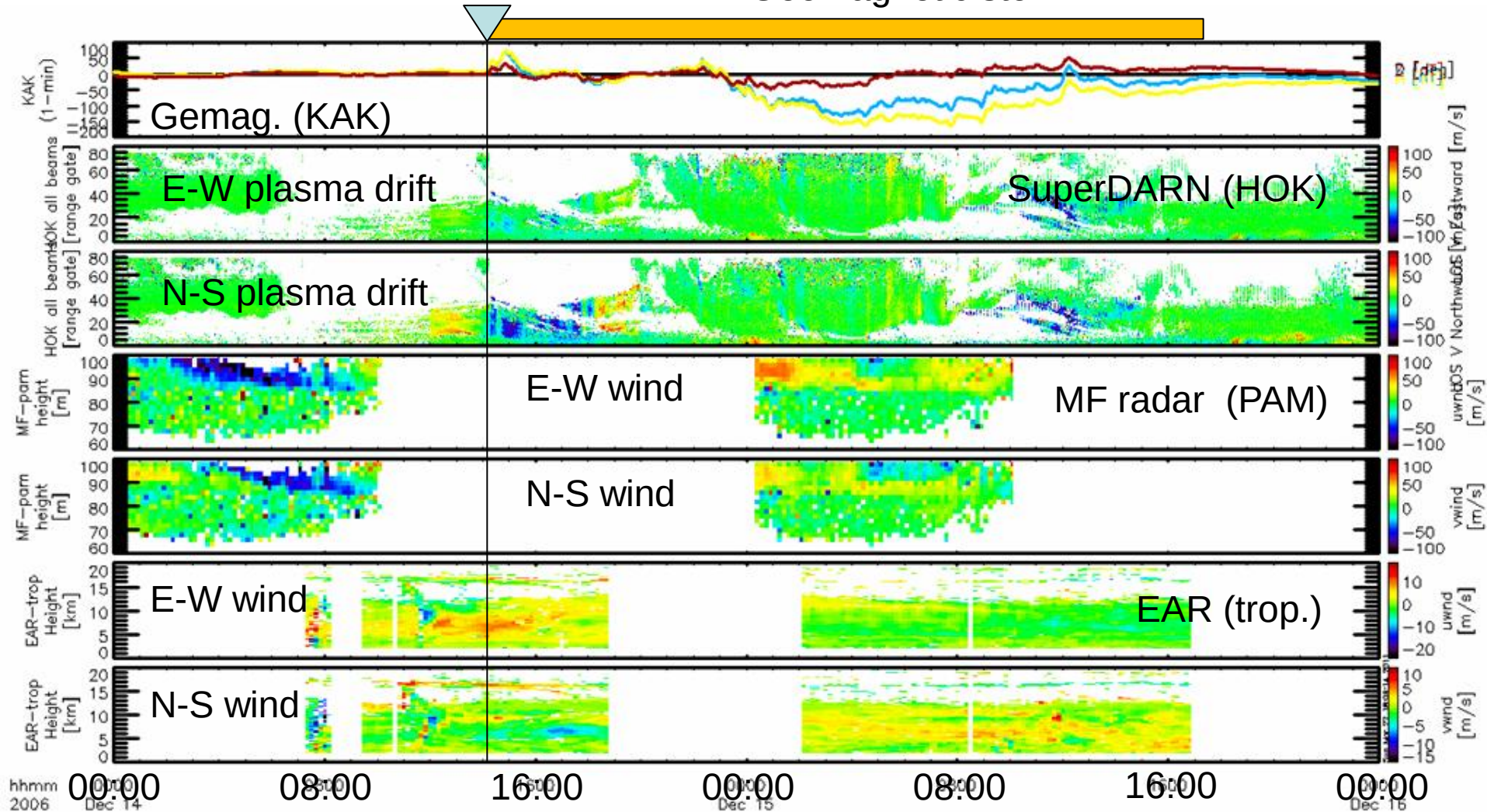
4. Demonstration of the UDAS software

4.3 An example of the upper atmosphere research

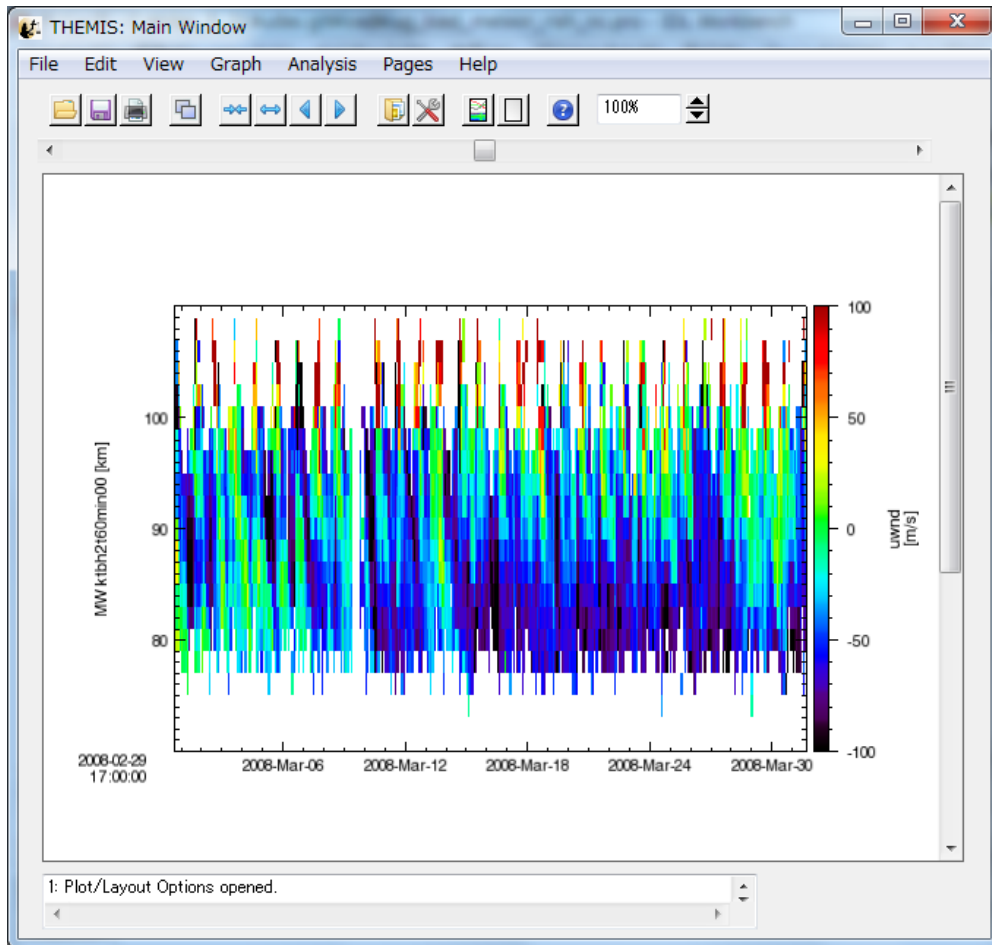
Storm commencement

Geomagnetic storm

2006/12/14-16



4.4 Analysis and plot of the observation data in the GUI mode



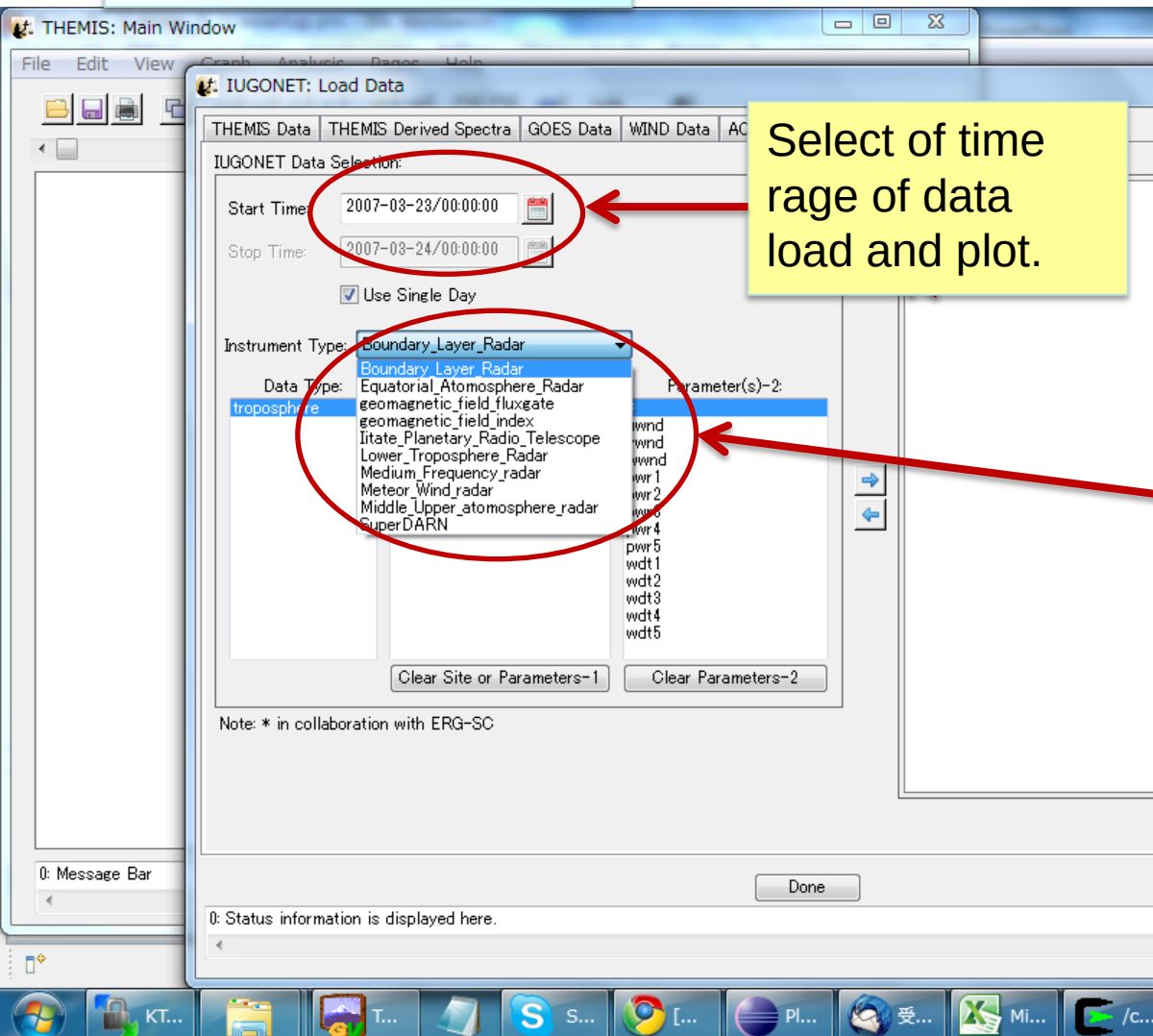
- Even the IDL beginners can easily analyze and make time series plots of various kinds of observation data in the GUI mode.
- The IUGONET project will provide the complied GUI execute file for the users with no IDL license in the future.
- ✂ Users can use this execute file with the **IDL-Virtual Machine** which is freely provided from the ITT.

✂ However, there are several modifications of the TDAS-GUI in order to execute this file on the IDL-VM with no error.

3. Demonstration of the UDAS software

3.4 Analysis and plot of the observation data in the GUI mode

Data load window



Select of time range of data load and plot.

Select of instruments and geomagnetic indices

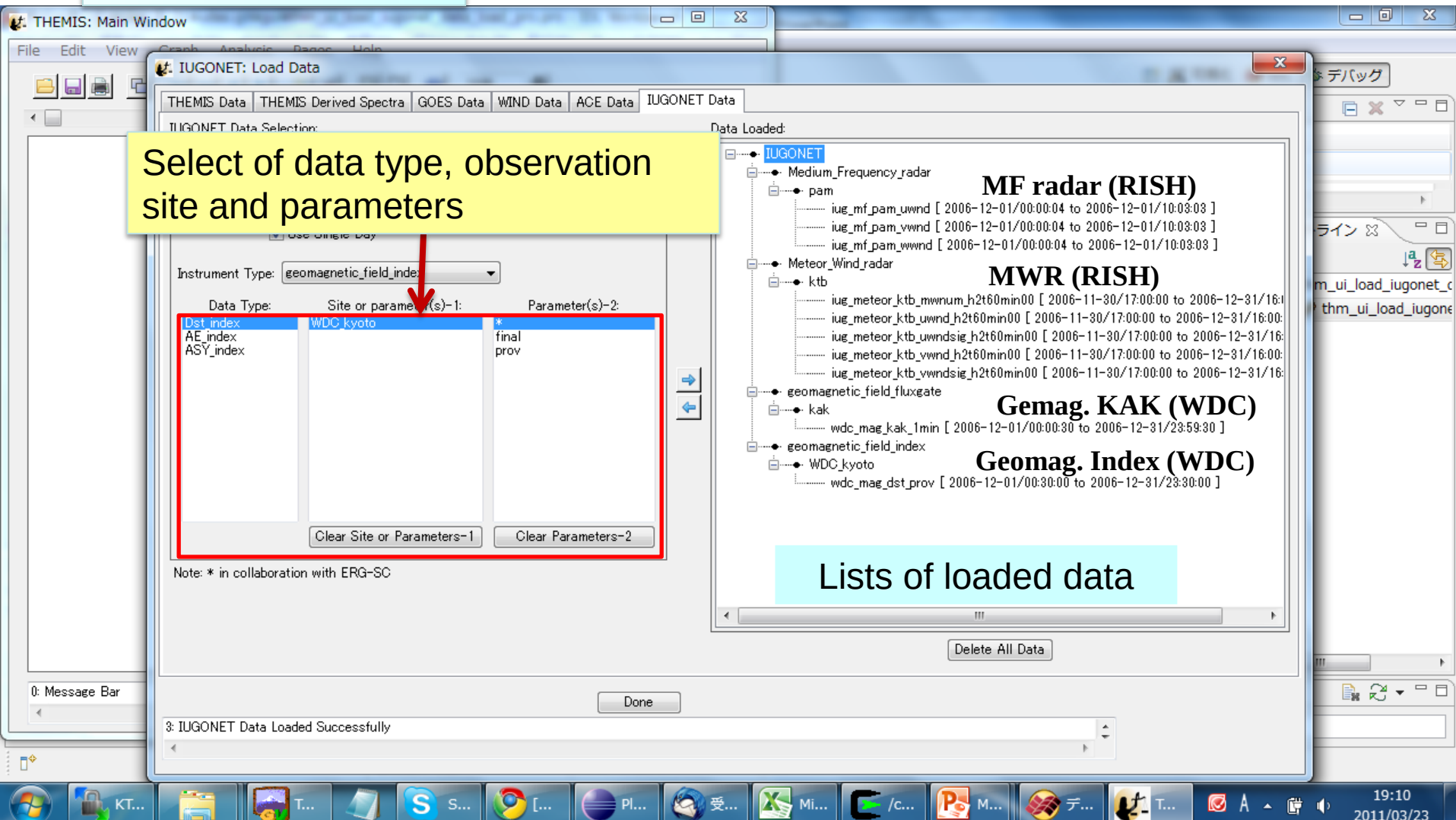
In the present version, you can select 10 items.

1. Geomagnetic indices
2. Fluxgate magnetometer
3. EAR
(Troposphere/Ionosphere)
4. MF radar
5. Meteor wind radar
6. MU radar
(Troposphere)
7. BLR
8. LTR
9. IPRT
10. SuperDARN

3. Demonstration of the UDAS software

3.4 Analysis and plot of the observation data in the GUI mode

Data load window



The screenshot shows the IUGONET: Load Data window. A yellow callout box with the text "Select of data type, observation site and parameters" points to the "Data Type:", "Site or parameter(s)-1:", and "Parameter(s)-2:" fields. The "Data Type:" field is set to "geomagnetic_field_index". The "Site or parameter(s)-1:" field is set to "WDC kyoto". The "Parameter(s)-2:" field is set to "* final prov". A red box highlights these three fields. Below the fields are buttons for "Clear Site or Parameters-1" and "Clear Parameters-2".

The "Data Loaded:" section on the right lists the loaded data:

- IUGONET**
 - Medium_Frequency_radar
 - pam
 - iug_mf_pam_uwnd [2006-12-01/00:00:04 to 2006-12-01/10:03:03]
 - iug_mf_pam_vwnd [2006-12-01/00:00:04 to 2006-12-01/10:03:03]
 - iug_mf_pam_wwnd [2006-12-01/00:00:04 to 2006-12-01/10:03:03]
 - Meteor_Wind_radar
 - ktb
 - iug_meteor_ktb_mwnum_h2t60min00 [2006-11-30/17:00:00 to 2006-12-31/16:00:00]
 - iug_meteor_ktb_uwnd_h2t60min00 [2006-11-30/17:00:00 to 2006-12-31/16:00:00]
 - iug_meteor_ktb_uwndsig_h2t60min00 [2006-11-30/17:00:00 to 2006-12-31/16:00:00]
 - iug_meteor_ktb_vwnd_h2t60min00 [2006-11-30/17:00:00 to 2006-12-31/16:00:00]
 - iug_meteor_ktb_vwndsig_h2t60min00 [2006-11-30/17:00:00 to 2006-12-31/16:00:00]
 - geomagnetic_field_fluxgate
 - kak
 - wdc_mag_kak_1min [2006-12-01/00:00:30 to 2006-12-31/23:59:30]
 - geomagnetic_field_index
 - WDC.kyoto
 - wdc_mag_dst_prov [2006-12-01/00:30:00 to 2006-12-31/23:30:00]

The "Lists of loaded data" section is highlighted with a light blue box. At the bottom, a status bar shows "IUGONET Data Loaded Successfully".

4.4 Analysis and plot of the observation data in the GUI mode

Acknowledgement window

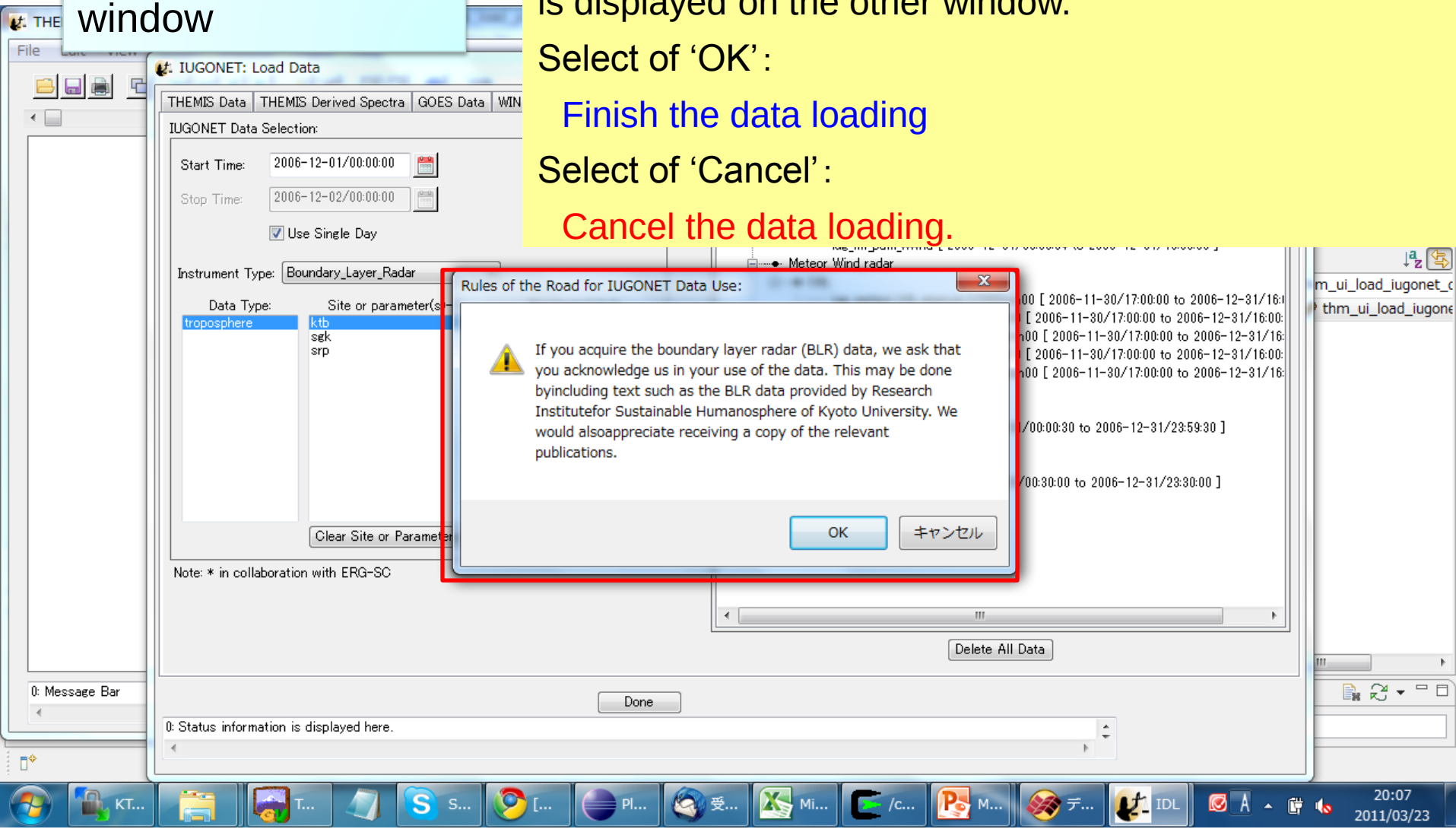
If you try to load your selected data, acknowledgement is displayed on the other window.

Select of 'OK':

Finish the data loading

Select of 'Cancel':

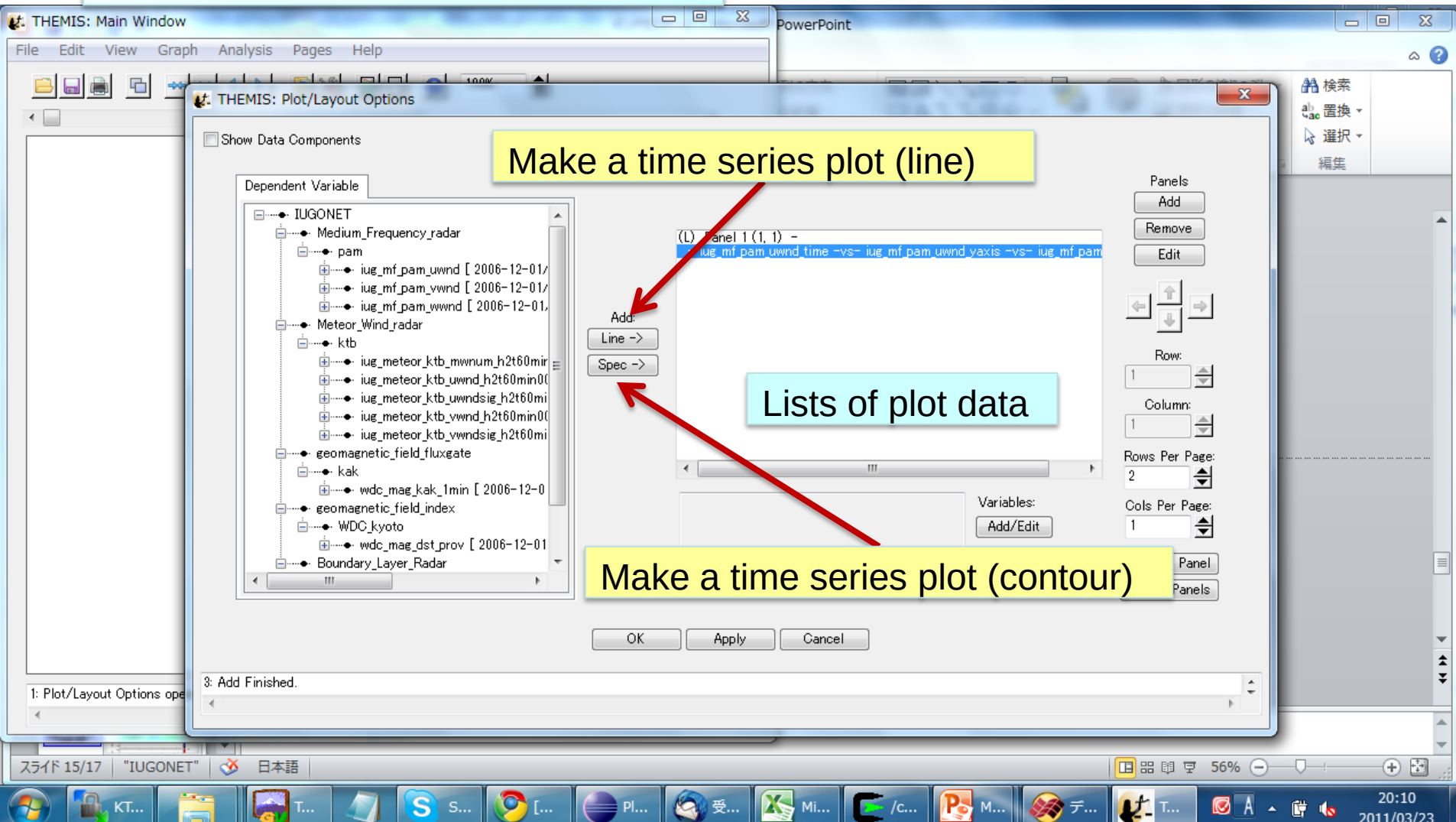
Cancel the data loading.



3. Demonstration of the UDAS software

3.4 Analysis and plot of the observation data in the GUI mode

Plot and layout option window



The screenshot shows the 'THEMIS: Plot/Layout Options' dialog box. The 'Dependent Variable' list on the left contains the following items:

- IUGONET
 - Medium_Frequency_radar
 - pam
 - iug_mf_pam_uwnd [2006-12-01/
 - iug_mf_pam_vwnd [2006-12-01/
 - iug_mf_pam_vwnd [2006-12-01/
 - Meteor_Wind_radar
 - ktb
 - iug_meteor_ktb_mwnum_h2t60mir
 - iug_meteor_ktb_uwnd_h2t60min00
 - iug_meteor_ktb_uwndsig_h2t60mi
 - iug_meteor_ktb_vwnd_h2t60min00
 - iug_meteor_ktb_vwndsig_h2t60mi
 - geomagnetic_field_fluxgate
 - kak
 - wdc_mag_kak_1min [2006-12-0
 - geomagnetic_field_index
 - WDC_kyoto
 - wdc_mag_dst_prov [2006-12-01
 - Boundary_Layer_Radar

Annotations on the window:

 - Make a time series plot (line)**: A yellow box with a red arrow pointing to the 'Line ->' button under the 'Add:' section.
 - Lists of plot data**: A light blue box with a red arrow pointing to the 'Spec ->' button under the 'Add:' section.
 - Make a time series plot (contour)**: A yellow box with a red arrow pointing to the 'Spec ->' button under the 'Add:' section.

The 'Add:' section contains two buttons: 'Line ->' and 'Spec ->'. The 'Spec ->' button is highlighted by a red arrow from the 'Lists of plot data' box. The 'Line ->' button is highlighted by a red arrow from the 'Make a time series plot (line)' box. The 'Spec ->' button is also highlighted by a red arrow from the 'Make a time series plot (contour)' box.

The 'Variables:' section contains an 'Add/Edit' button. The 'Panels' section contains 'Add', 'Remove', and 'Edit' buttons, along with 'Row', 'Column', 'Rows Per Page', and 'Cols Per Page' settings. The 'Row' is set to 1, 'Column' is set to 1, 'Rows Per Page' is set to 2, and 'Cols Per Page' is set to 1.

The 'OK', 'Apply', and 'Cancel' buttons are at the bottom of the dialog box.

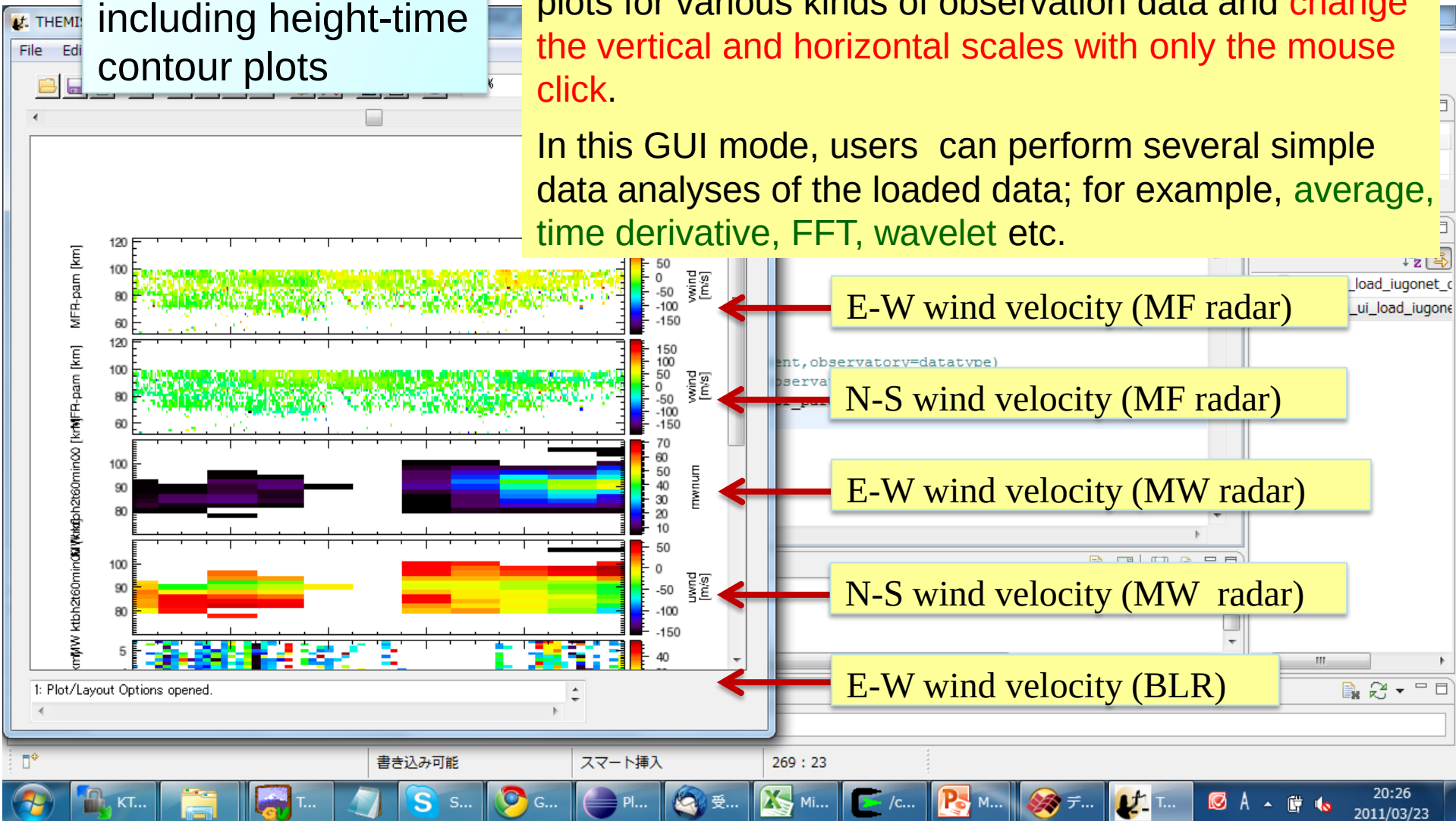
At the bottom left of the window, a status bar shows '1: Plot/Layout Options open' and '3: Add Finished.'

3.4 Analysis and plot of the observation data in the GUI mode

GUI top window including height-time contour plots

Users can easily make time series contour and line plots for various kinds of observation data and **change the vertical and horizontal scales with only the mouse click.**

In this GUI mode, users can perform several simple data analyses of the loaded data; for example, **average, time derivative, FFT, wavelet** etc.

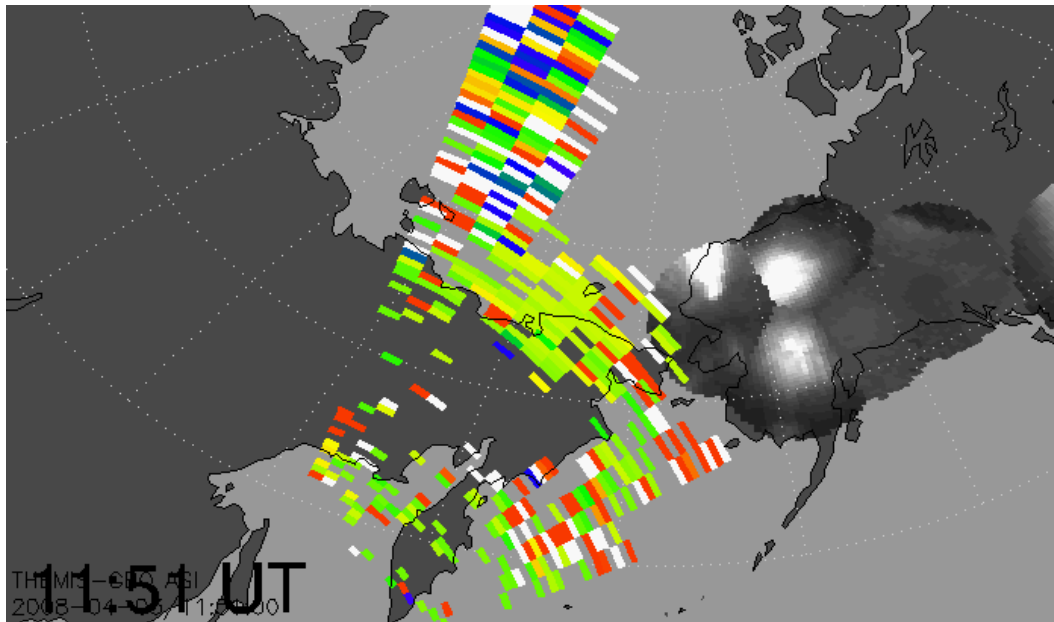


5.1 Summary and future plan of the UDAS software

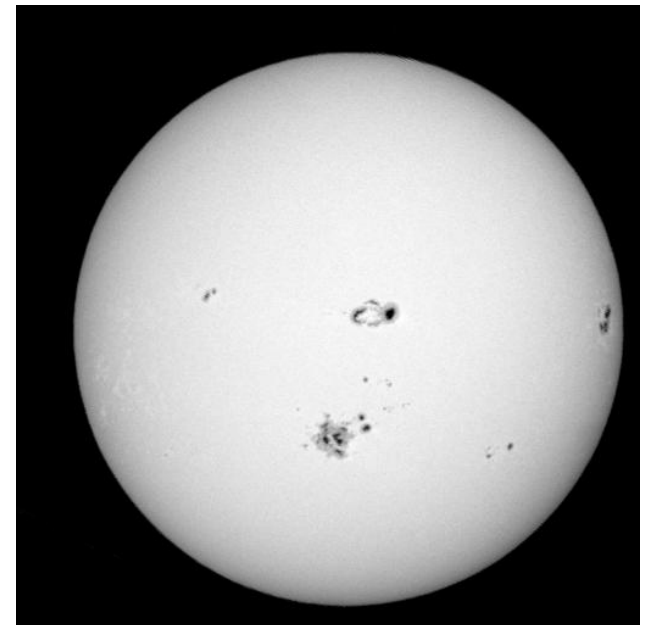
- ★ We have developed the metadata database and integrated analysis software for ground observation data of the upper atmosphere in our IUGONET project.
 - We develop the integrated analysis software which depends on the observation data of each institute, on the basis of the TDAS library written by the IDL language.
 - The analysis software will be open for everybody who studies the Earth's atmosphere after May this year.
 - The IUGONET project will provide the complied GUI execute file (IDL save file) for the users with no IDL license in the future.
- ★ We have started the cross-cutting research using various kinds of observation data provided from the IUGONET project. Our goal is to clarify the long-term variation of the upper atmosphere.

5.2 Future plan of development of the UDAS software

- The UDAS beta version does not include load procedures and plot tools of two-dimension data.
- We will develop the load and plot tools of two-dimension data (Sun, SuperDARN, Aurora) and open them for everybody as soon as possible next fiscal year.



Two-dimensinal plot tool of SuperDARN radar data



FMT photosphere picture