



Database for upper atmospheric science ~Activity of the IUGONET project~

超高層大気研究のためのデータベース
~IUGONETプロジェクトの活動~

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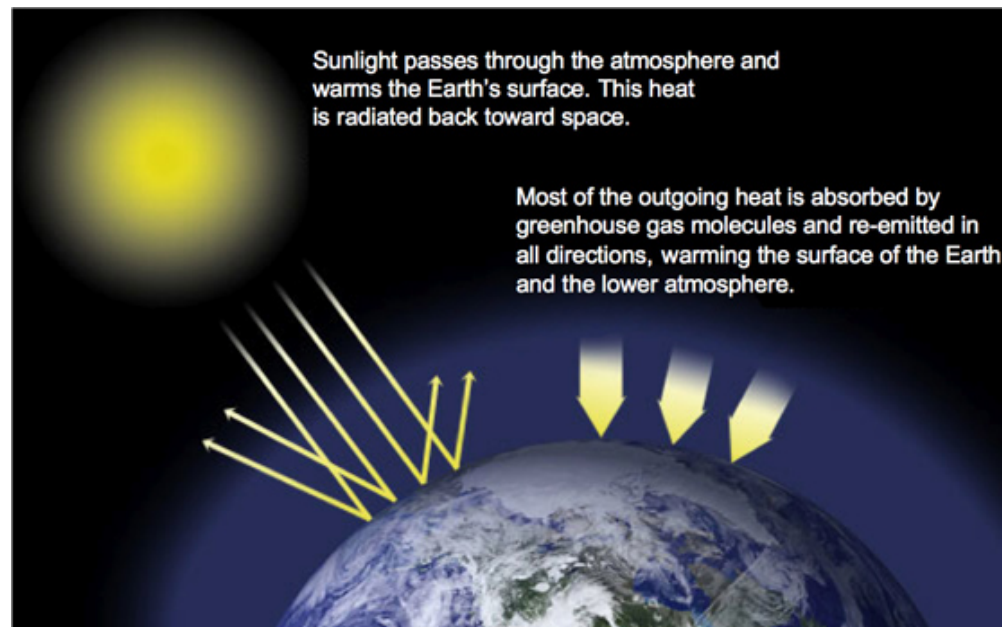


1. 国立極地研究所宙空圏研究グループ
(Space and Upper Atmospheric Sciences Group,
National Institute of Polar Research)



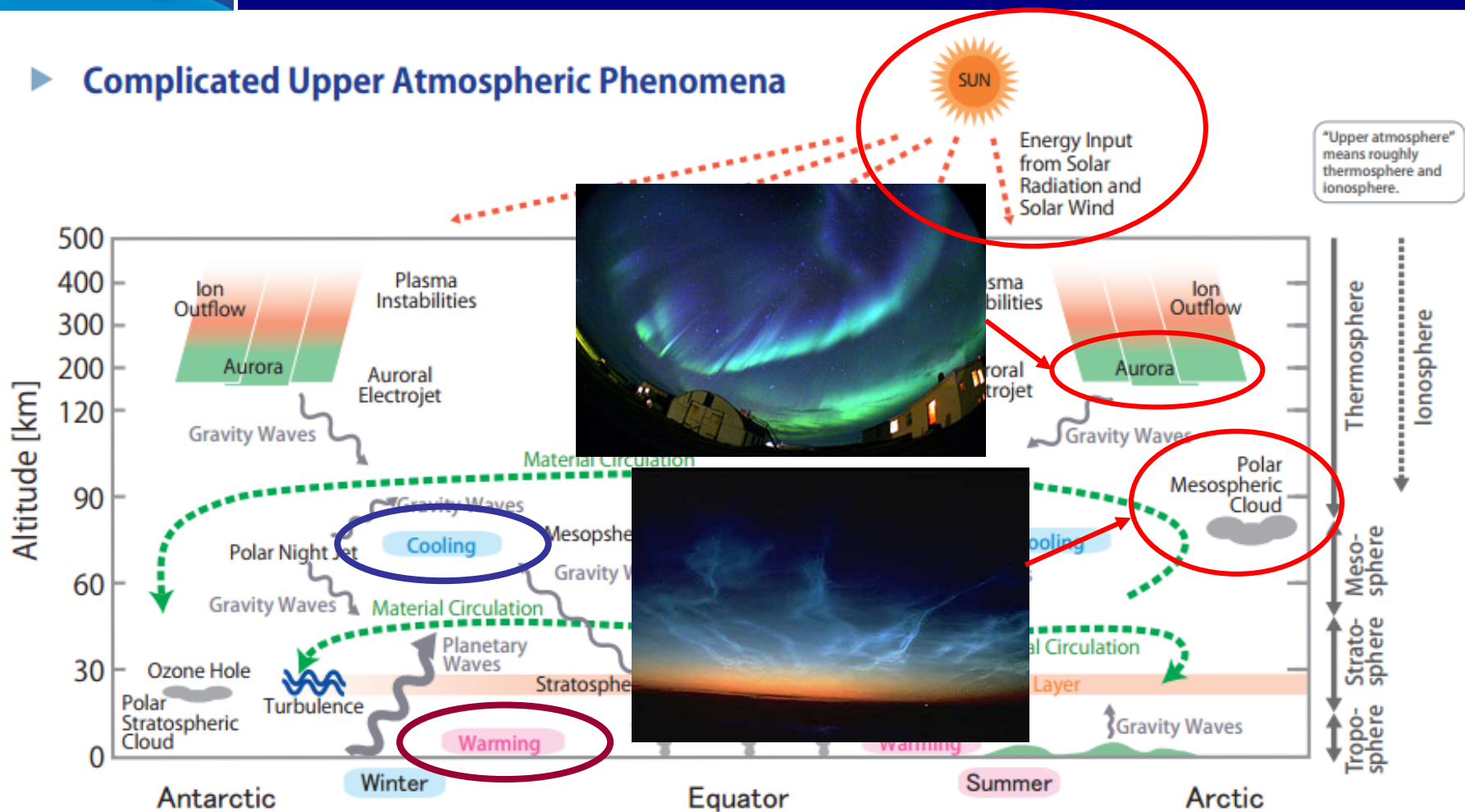
exemplified by Global Warming

- Essentially global phenomena.
- Caused by many complex factors, such as human activity, atmospheric circulation, volcanic eruption, and solar activity.



<http://climate.nasa.gov/causes/>

► Complicated Upper Atmospheric Phenomena

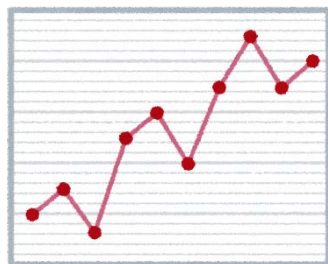


- Consists of multiple layers existing from about 60 km altitude to the Sun.
- Meridional coupling also plays an important role in the structure of the Earth's atmosphere.

- **Variety of data sets**
 - Data are obtained by various kinds of instruments, such as telescope, imager, radar, and magnetometer (on the ground and spacecraft).
 - Various physical parameters for neutral gas and plasma.
- **Long-term variation**
 - Long-term monitoring observation is important.
- **Collaboration & Data sharing**
 - Since phenomena in the upper atmosphere often occur globally and/or across multiple layers, collaboration and data sharing are indispensable to understand the mechanism completely.

① Analyze only one kind of data obtained by themselves

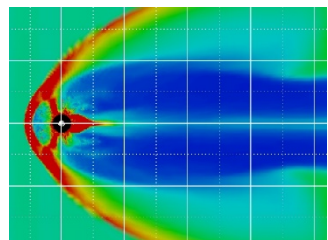
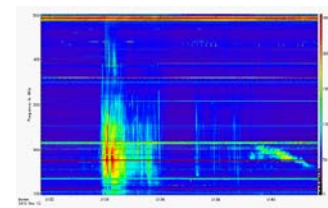
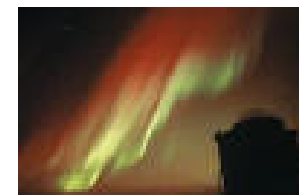
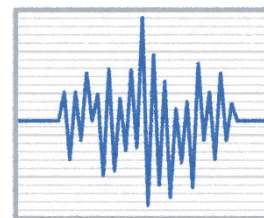
(e.g., geomagnetic field)



② Analyze comprehensively many kinds of data provided by data providers

(e.g., radar data, images, satellite data)

Quasi-real time

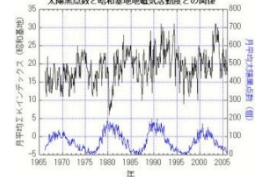


③ Compare observed data with simulation,
Data assimilation

(1) Observations by the Japanese Antarctic Research Expedition (JARE)



Auroral observation at Syowa (1959~)



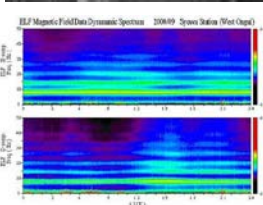
Geomagnetic observation at Syowa (1966~)



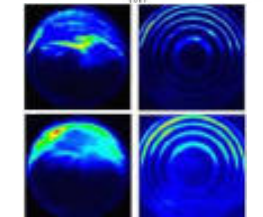
Upper atmosphere monitoring observation at Syowa (1981~)



Imaging riometer at Syowa (1992~)



1-100Hz ULF/ELF electromagnetic wave at Syowa (2000~)



Fabry-Perot imager at Syowa (2001~)



SuperDARN HF radar (1995~)



MF radar (1999~)



DMSP satellite data received at Syowa (1997~)



Akebono satellite data received at Syowa (1989~)

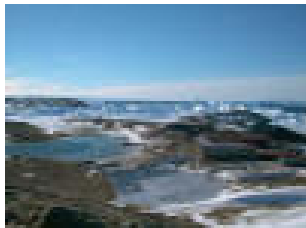


Unmanned magnetometer network (2003~)

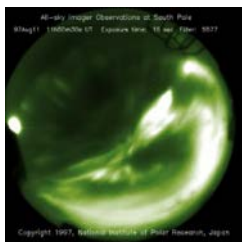


Polar Patrol Balloon (PPB) experiment (2003~2004)

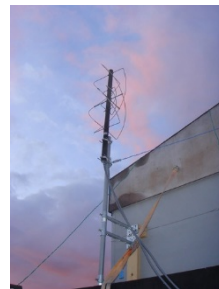
(2) International cooperative observations in the Antarctic



Upper atmosphere physics observation at Zhongshan station (1994~)



Auroral imager at South Pole station (1997~)



Digital beacon receiver observation (2011~)

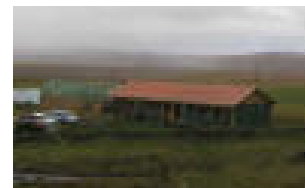


Aurora Spectrograph (2000~)

(3) Observations in the Arctic



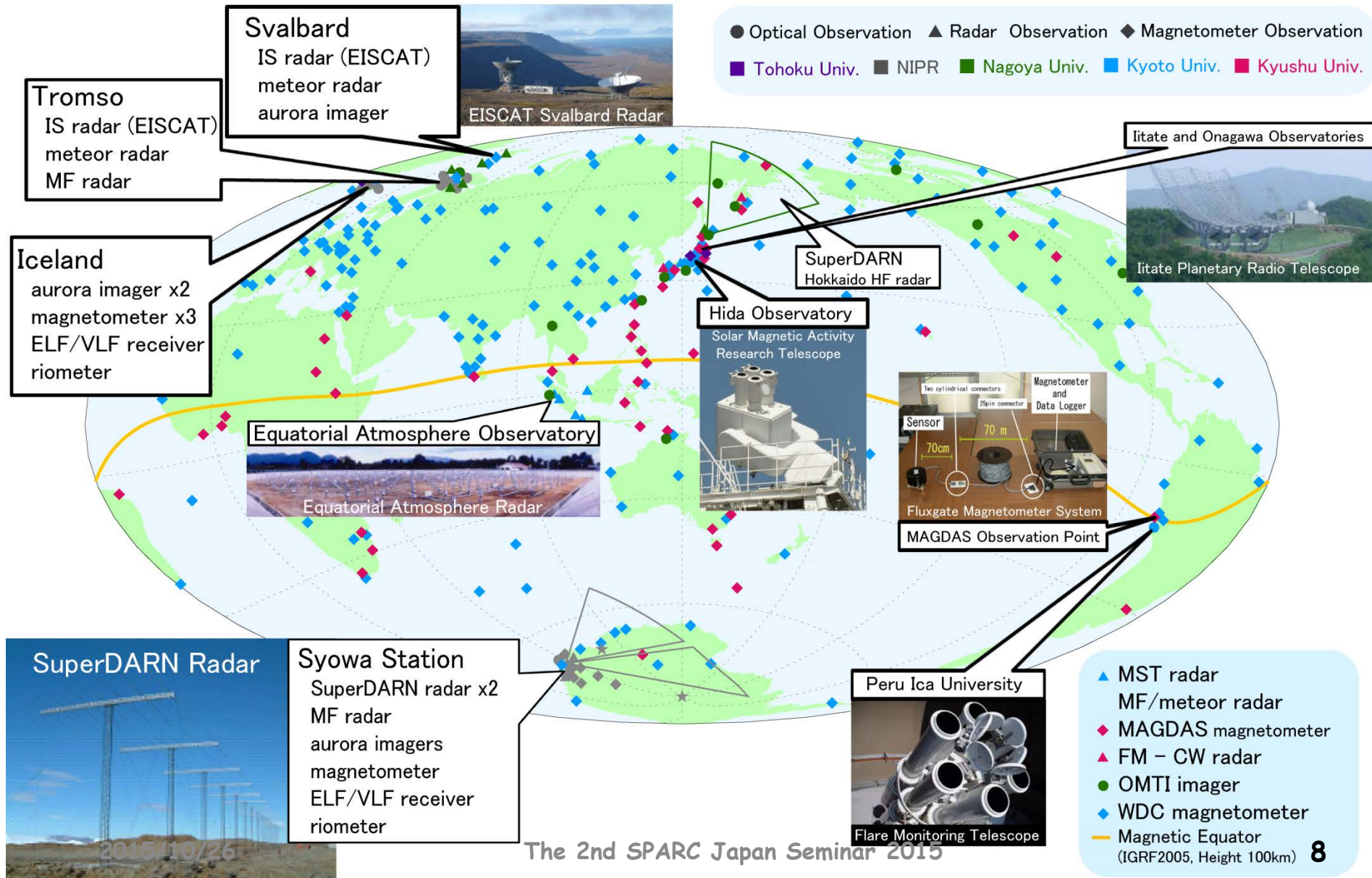
All-sky/Narrow FOV parallel Imager Observations at Tromso/Longyearbyen (2010~)



Conjugate observation at Iceland (1984~)



EISCAT radar (1984~)



- Database has been **maintained individually by each university/institute**, so it is difficult for researchers to discover and access the data due to lack of information of them.
- Database has been built and maintained by **domain researchers**.
- Due to **a variety of data**, collection of the data and metadata is time consuming.
- File format is different for each instrument type, thus it usually takes time to analyze many kinds of data.

IUGONET : **I**nter-university **U**pper atmosphere **G**lobal **O**bservation **NET**work.

Goals of the IUGONET project:

- ◆ To **provide new research infrastructure that enables the upper atmosphere data to be shared**, which have been archived by the members of IUGONET since the International Geophysical Year (1957-1958).
- ◆ To **comprehensively understand the mechanisms of long-term variations in the upper atmosphere** (and also promote new interdisciplinary studies regarding the upper atmosphere).



本プロジェクトは、文部科学省特別教育研究経費(研究推進) [平成21年度] および特別経費(プロジェクト分) [平成22年度-26年度] の交付を受けて実施。

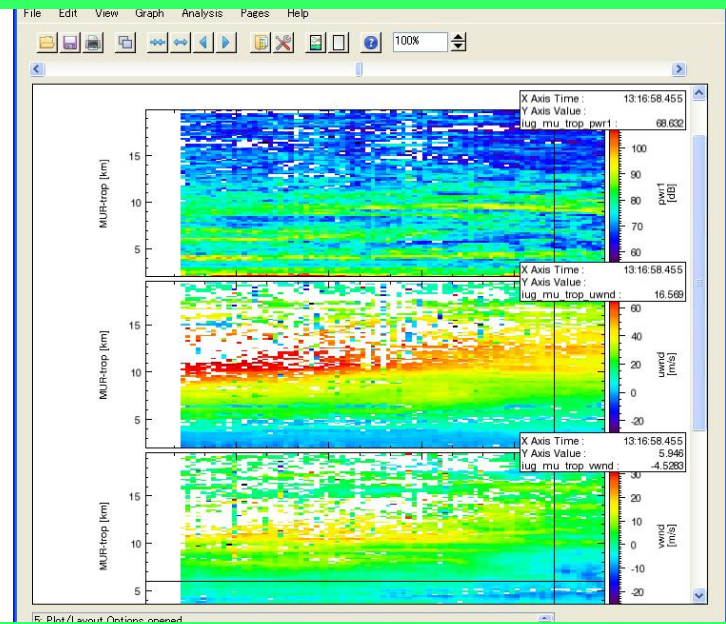
- ◆ **Metadata Database** for cross-searching various data distributed across the members of IUGONET
- ◆ **Data Analysis Software** for visualizing and analyzing various data in an integrated fashion

Metadata Database

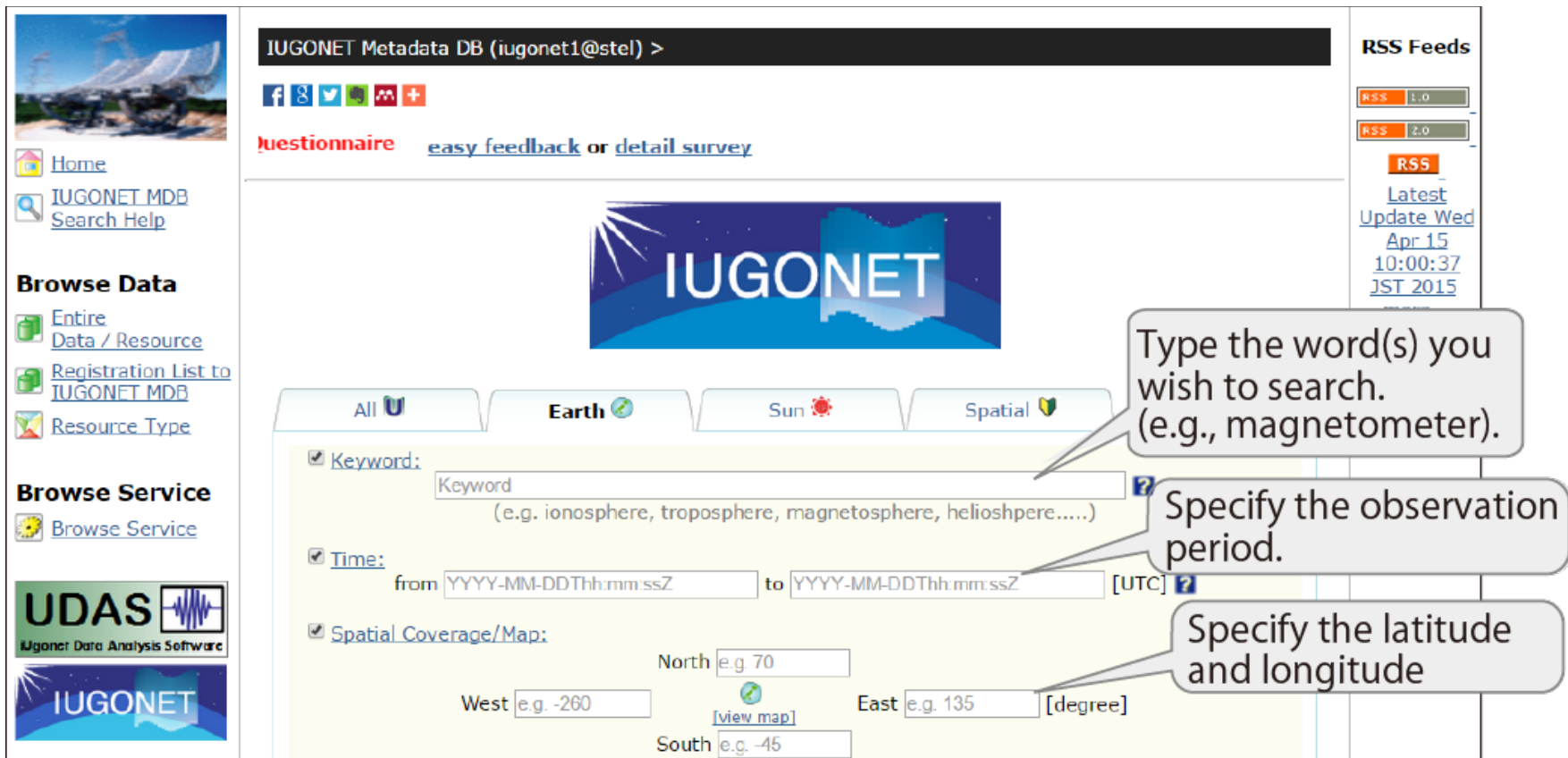


<http://search.iugonet.org/iugonet>

Data Analysis Software



<http://www.iugonet.org/software.html>



The screenshot shows the IUGONET Metadata Database search interface. The top navigation bar includes links for Home, IUGONET MDB, Search Help, and a Questionnaire. The main search area features a large IUGONET logo and a search form with the following fields:

- Keyword:** A text input field for searching by keyword (e.g., ionosphere, troposphere, magnetosphere, heliosphere....).
- Time:** Two date-time input fields for specifying the observation period (from YYYY-MM-DDThh:mm:ssZ to YYYY-MM-DDThh:mm:ssZ [UTC]).
- Spatial Coverage/Map:** Four input fields for specifying latitude and longitude (North, West, East, South) in degrees, with a [view map] link.

Callouts provide additional guidance:

- "Type the word(s) you wish to search. (e.g., magnetometer)." points to the Keyword field.
- "Specify the observation period." points to the Time fields.
- "Specify the latitude and longitude" points to the Spatial Coverage/Map fields.

The right sidebar contains RSS Feeds for RSS 1.0, RSS 2.0, and a Latest Update Wed Apr 15 10:00:37 JST 2015.

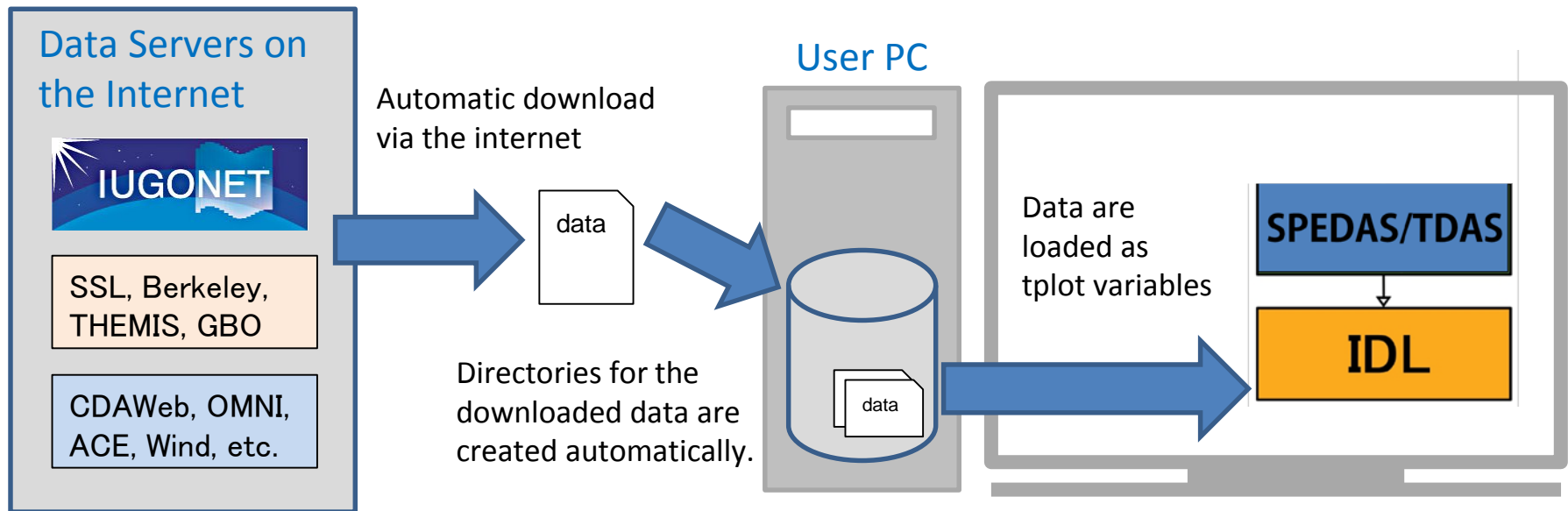
- The IUGONET common metadata format was created on the basis of the **Space Physics Archive Search and Extract (spase)** format.
- The IUGONET-MDB is a modified system based on **DSpace**, an open-source software that creates open digital repositories.
- It has OpenSearch interface for sharing the search results with other websites and data analysis software.



Data Analysis Software (SPEDAS)

SPEDAS : Space Physics Environment Data Analysis Software.

- Grass-roots data analysis software for Space Physics Community.
- Is based on Interactive Data Language (IDL).
- Was developed by scientists and programmers of the UC Berkeley's Space Sciences Laboratory, UCLA's IGPP and other contributors.

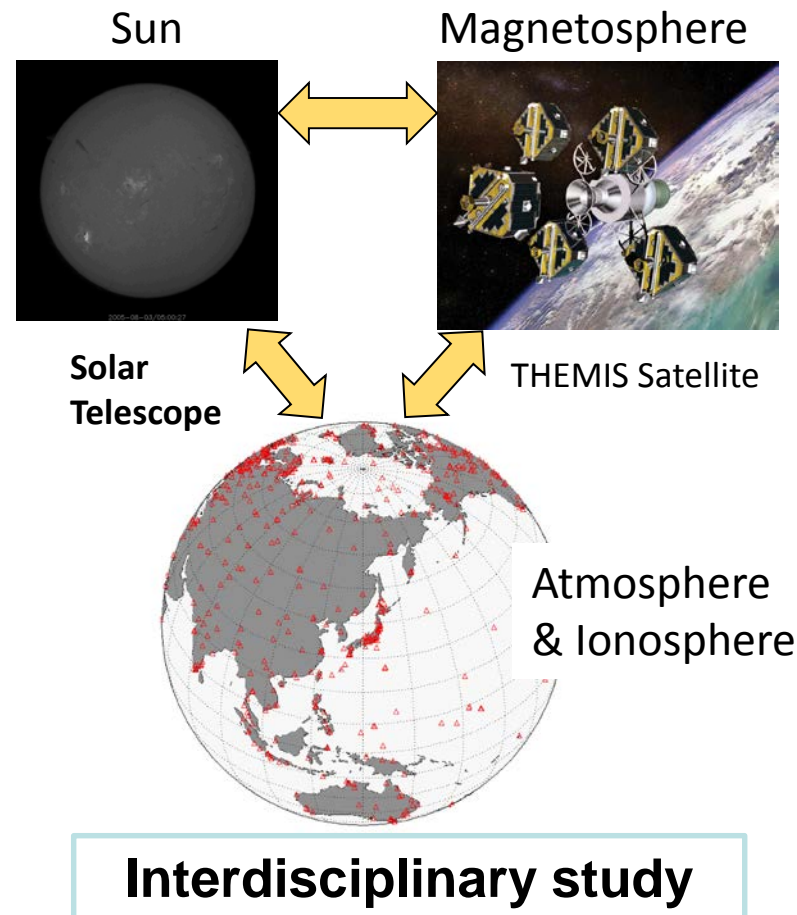
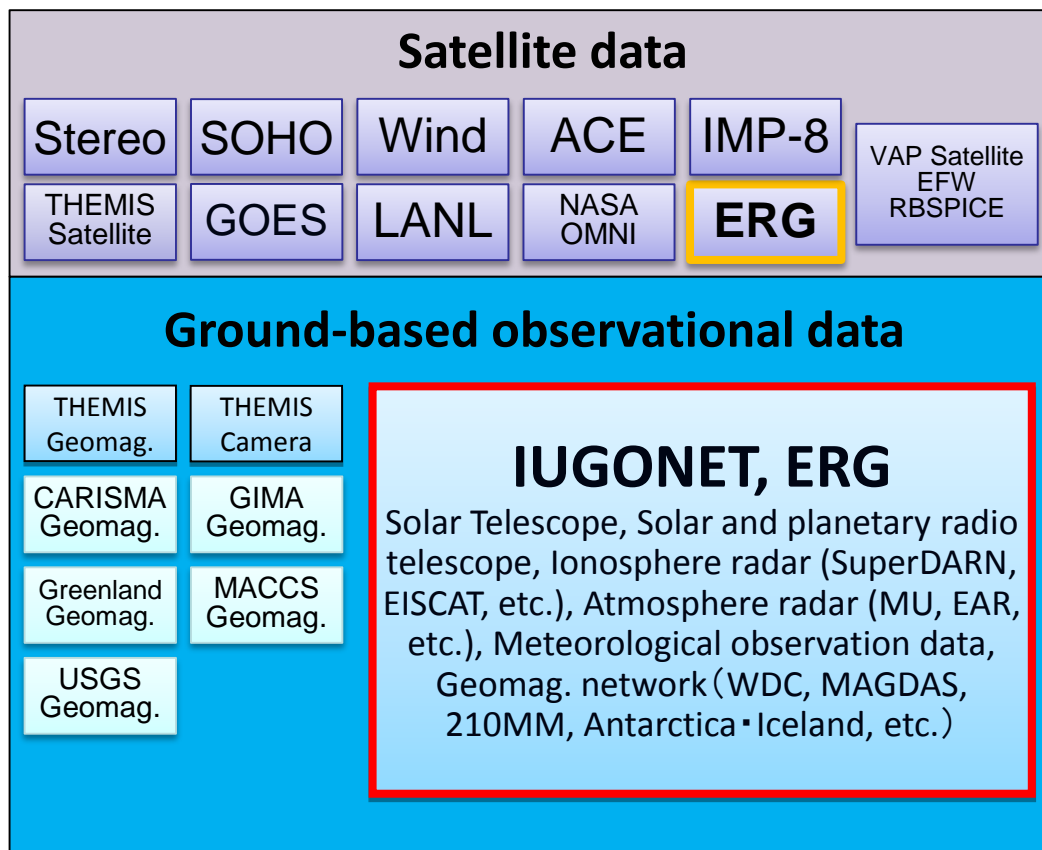


Data can be easily plotted, for example, by only three basic commands.

1. Set a time period
2. Load *** data
3. Plot the loaded data

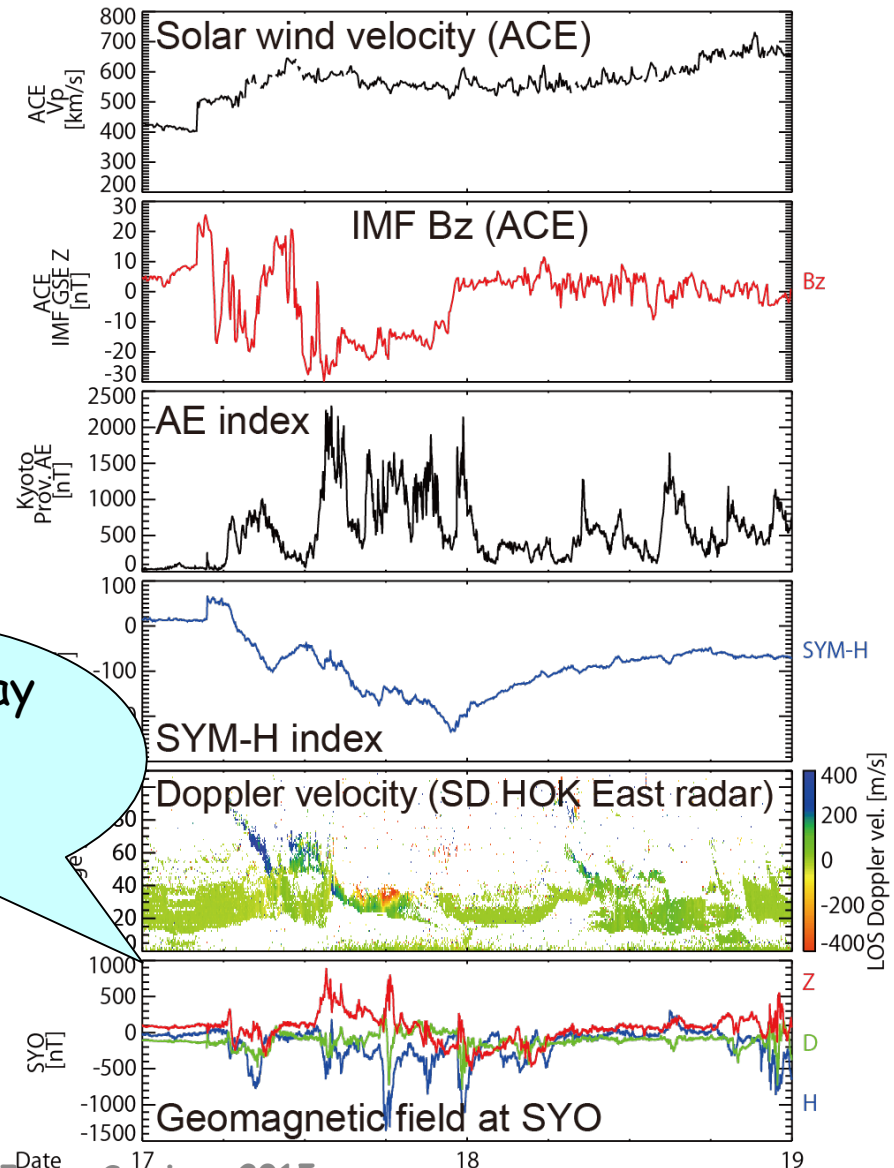
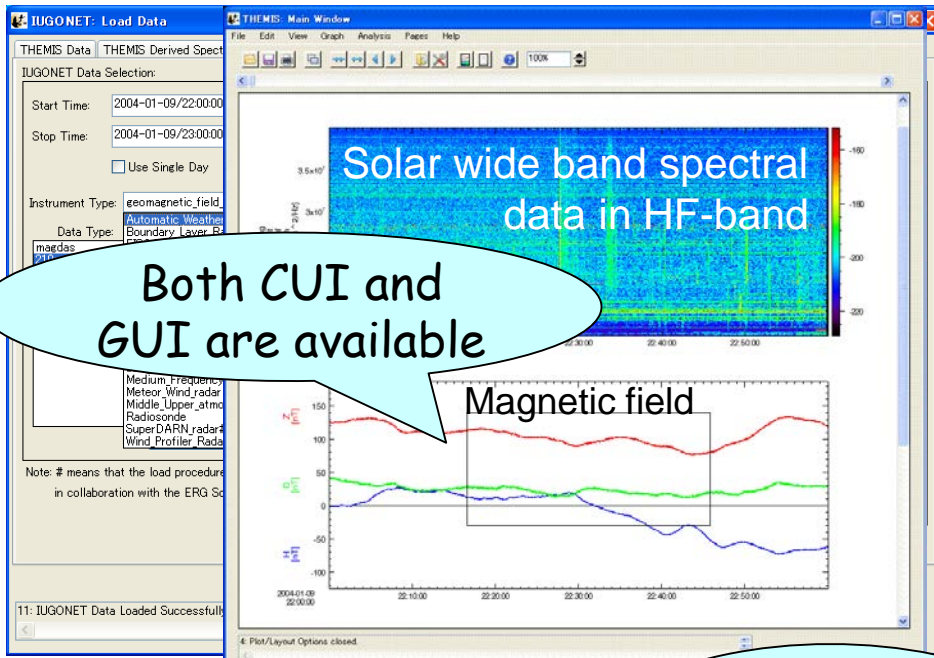
```
timespan, 'yyyy-mm-dd'  
iug_load_***  
tplot, ++
```

Data supported by SPEDAS

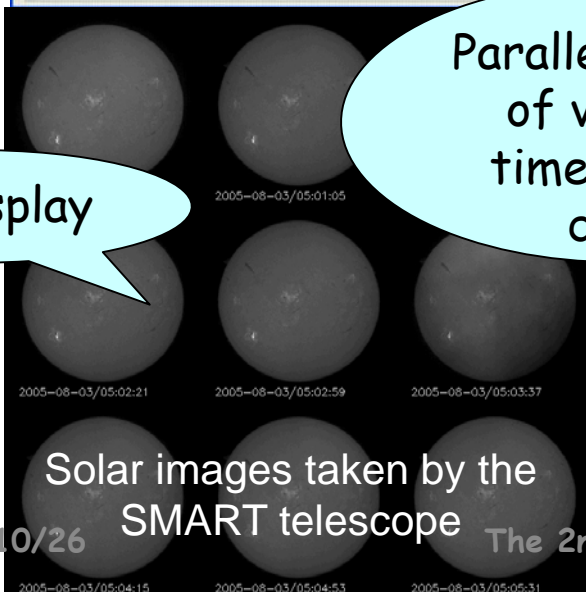


- ✓ Many missions have provided plugins for SPEDAS.
- ✓ IUGONET has also provided a plugin for SPEDAS, which includes many routines for loading various ground-based observation data.
- ✓ SPEDAS is suitable for interdisciplinary study of the upper atmosphere.

Examples of plots by using SPEDAS



2D display



Solar images taken by the SMART telescope

The other institutes and universities in the Japanese STP community (JAXA, Hokkaido Univ., Kanazawa Univ., ...)


Japanese Geoscience Group

STP community in the countries of Asia/Africa


NASA/Virtual Observatory (VMO, VHO, VWO,...)








Support for continuous activity of IUGONET from the international scientific activities and council.



IUGONET welcomes any type of support and feedback from users!

- The upper atmosphere, corresponding to the region from the Earth's atmosphere about 60 km altitude to the Sun, is characterized by the existence of various data observed with telescope, camera, radar, etc. on the ground and satellite.
- It was difficult to find and access such various data, because these data are distributed across universities /institutes.
- The IUGONET project has developed the infrastructure for the upper atmospheric sciences, such as metadata database and data analysis software that allows researchers to search, retrieve, and analyze various data.