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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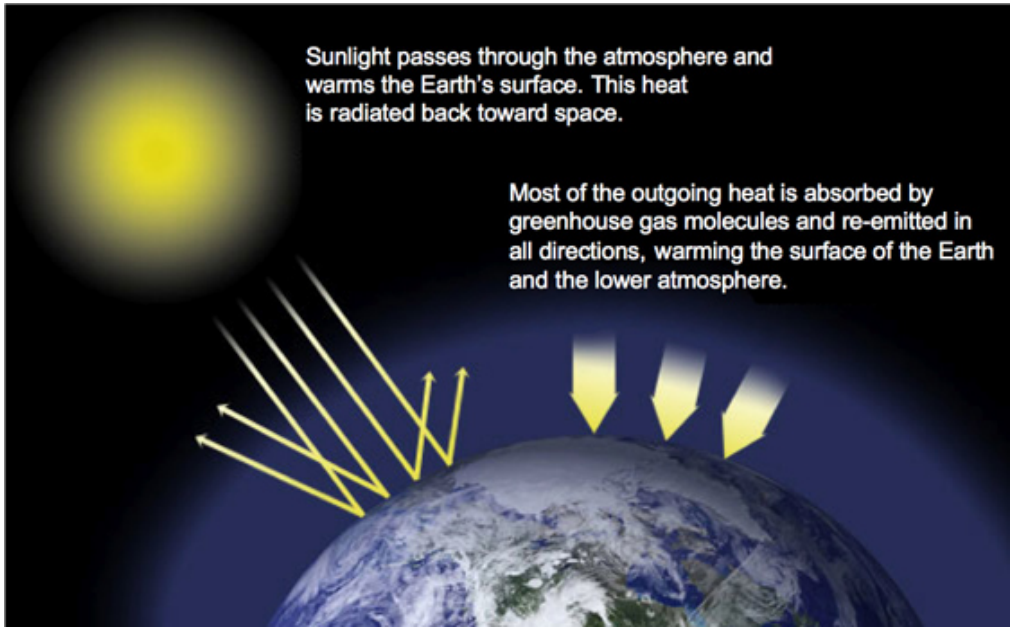
Climate change / Global environmental problems

exemplified by Global Warming

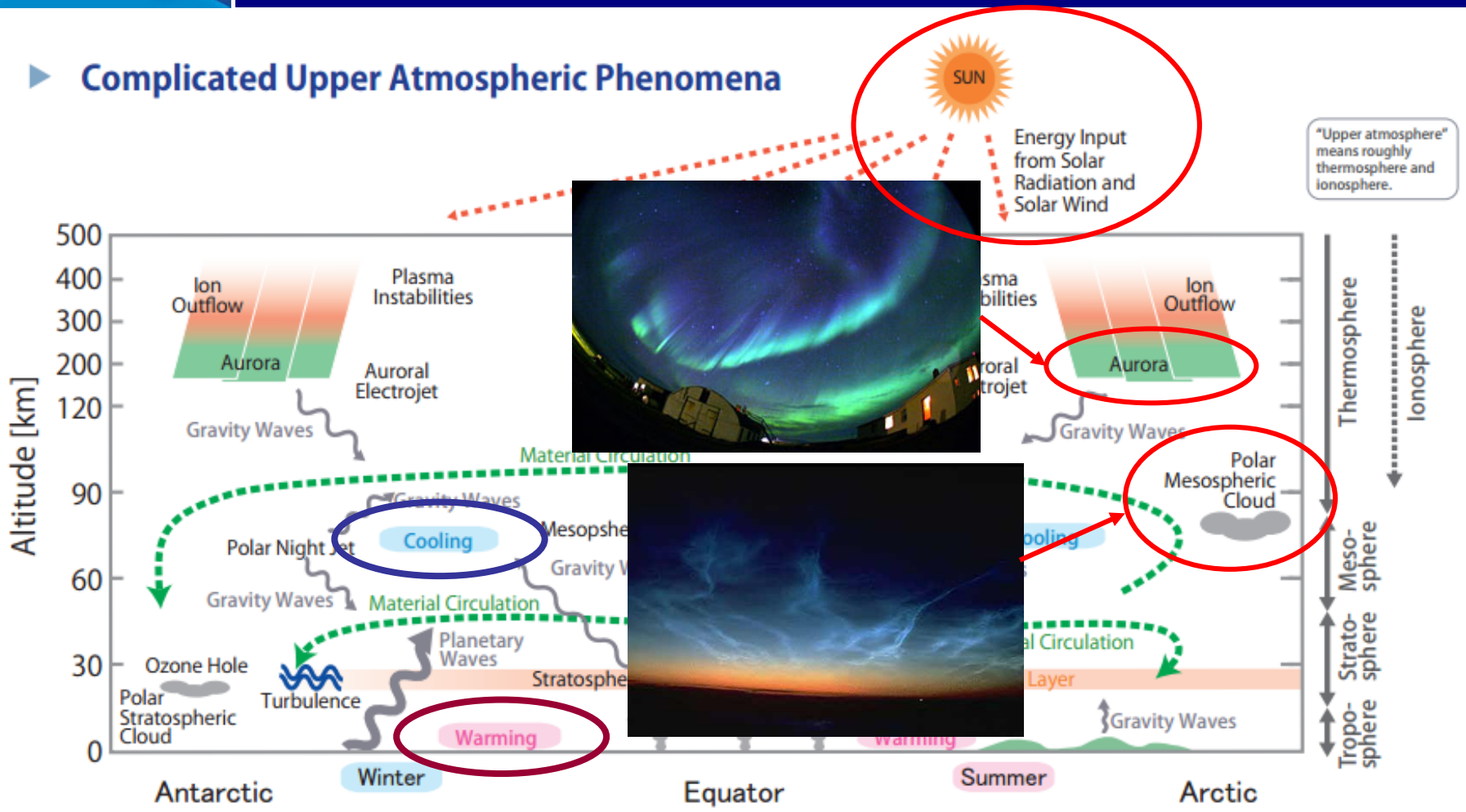
- Essentially global phenomena.
- Caused by many complex factors, such as human activity, atmospheric circulation, volcanic eruption, and solar activity.



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

Upper Atmosphere

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.

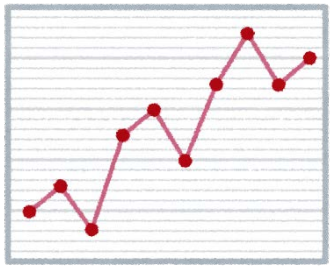
Characteristics of Upper Atmospheric Sciences

- 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.

Change in methods of upper atmospheric research

① Analyze only one kind of data obtained by themselves

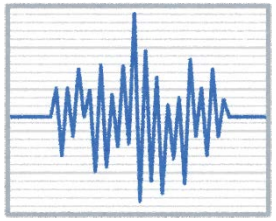
(e.g., geomagnetic field)

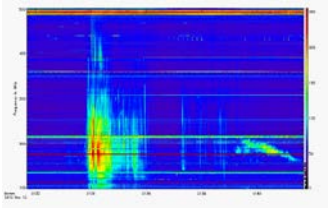


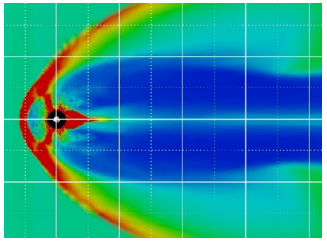
Quasi-real time

② Analyze comprehensively many kinds of data provided by data providers

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





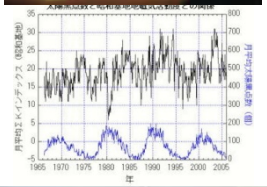


③ Compare observed data with simulation, Data assimilation

Upper atmospheric data in NIPR (1)

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

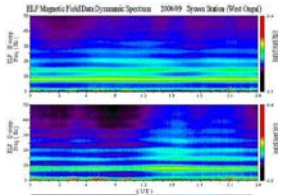
Auroral observation at Syowa (1959～)



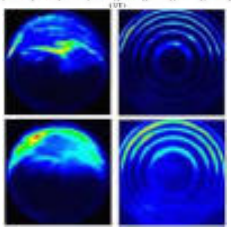
Geomagnetic observation at Syowa (1966～)

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～)

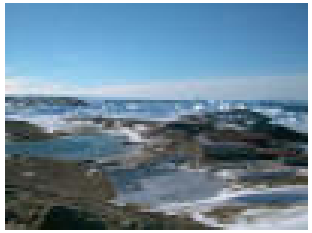
Akebono satellite data received at Syowa (1989～)

Unmanned magnetometer network (2003～)

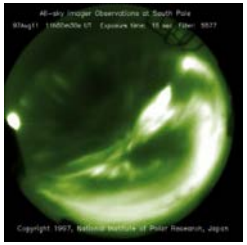
Polar Patrol Balloon (PPB) experiment (2003～2004)

Upper atmospheric data in NIPR (2)

(2) International cooperative observations in the Antarctic



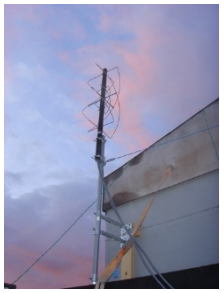
Upper atmosphere physics observation at Zhongshan station (1994～)



Auroral imager at South Pole station (1997～)

(3) Observations in the Arctic

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



Digital beacon receiver observation (2011～)

Aurora Spectrograph (2000～)

Conjugate observation at Iceland (1984～)

EISCAT radar (1984～)

Global network of ground-based observations

● Optical Observation ▲ Radar Observation ◆ Magnetometer Observation

■ Tohoku Univ. ■ NIPR ■ Nagoya Univ. ■ Kyoto Univ. ■ Kyushu Univ.

Svalbard
IS radar (EISCAT)
meteor radar
aurora imager

Tromso
IS radar (EISCAT)
meteor radar
MF radar

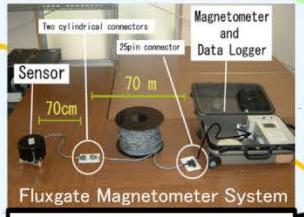
Iceland
aurora imager x2
magnetometer x3
ELF/VLF receiver
riometer

Iitate and Onagawa Observatories

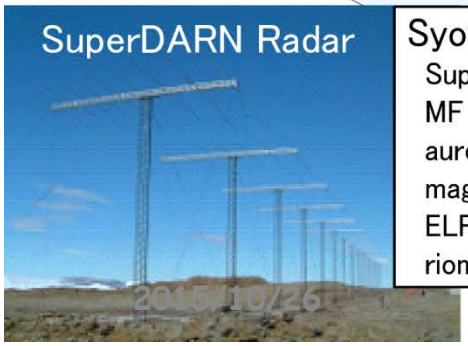
SuperDARN
Hokkaido HF radar

Hida Observatory
Solar Magnetic Activity
Research Telescope

Equatorial Atmosphere Observatory



MAGDAS Observation Point



Syowa Station
SuperDARN radar x2
MF radar
aurora imagers
magnetometer
ELF/VLF receiver
riometer

Peru Ica University

▲ MST radar
MF/meteor radar
◆ MAGDAS magnetometer
▲ FM – CW radar
● OMTI imager
◆ WDC magnetometer
— Magnetic Equator
(IGRF2005, Height 100km)

Current issues in the upper atmospheric research in Japan …

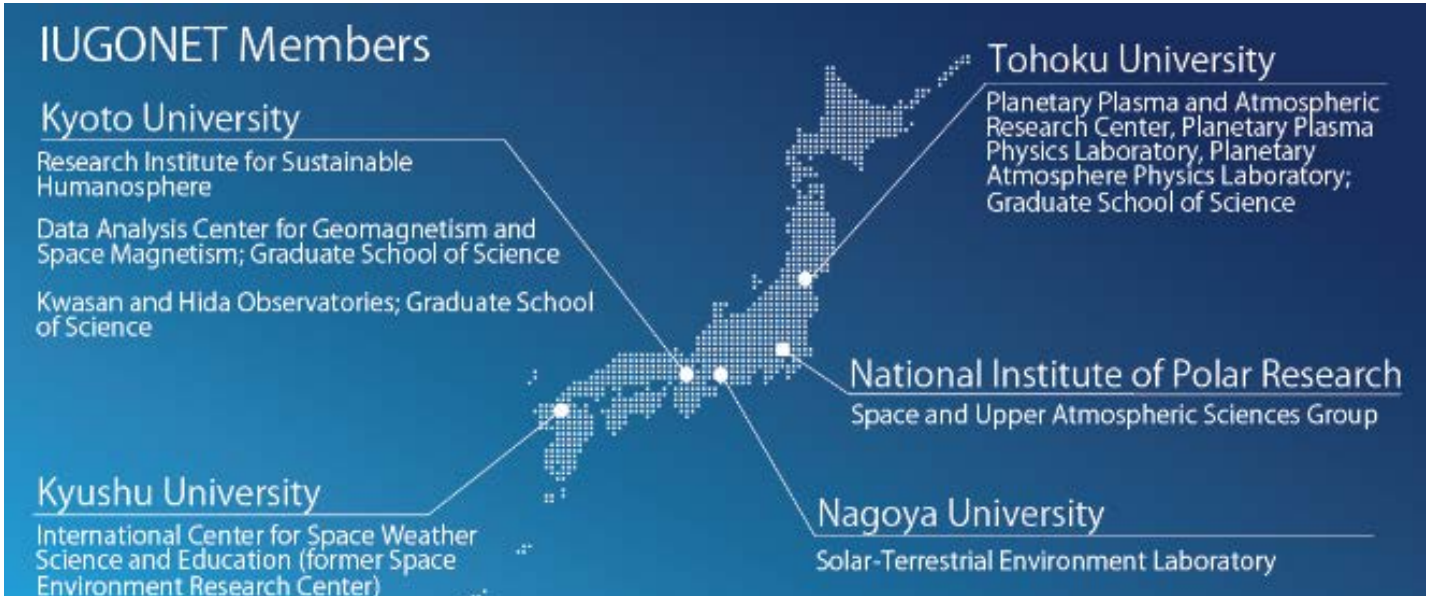
- Database has been maintained individually by each university/institute, so it is difficult for researchers to discover and access the data due to lack of information of them.
- Database has been built and maintained by domain researchers.
- Due to a variety of data, collection of the data and metadata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

IUGONET project

IUGONET : Inter-university Upper atmosphere Global Observation NETwork.

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).



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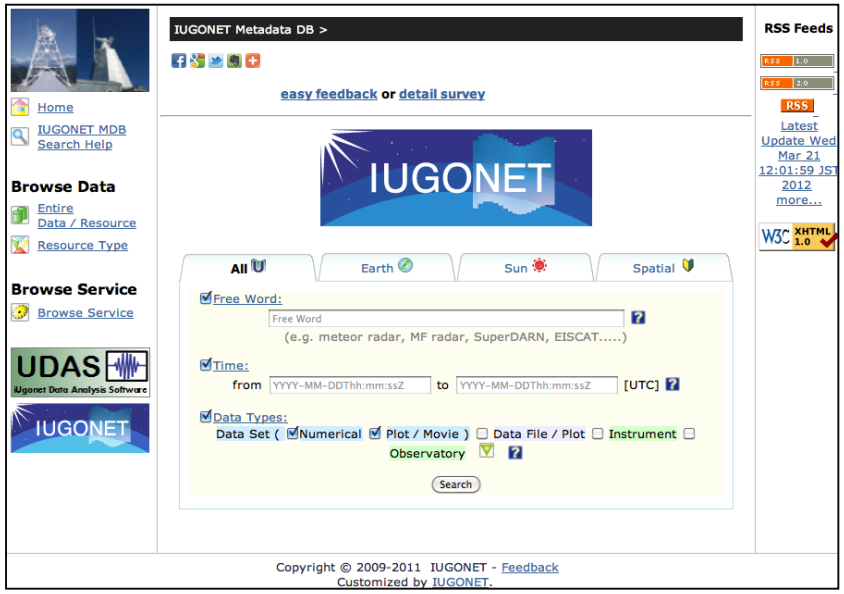
Main tools developed by the IUGONET

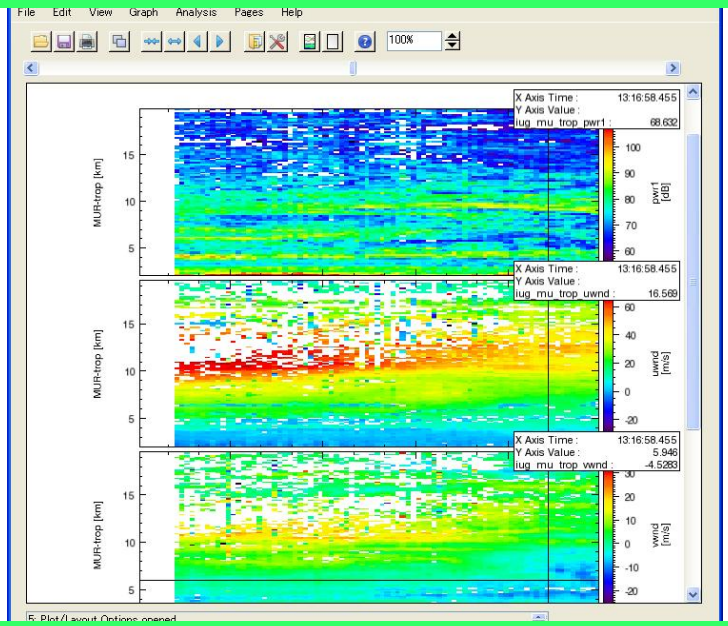
- Metadata Database for cross-searching various data distributed across the members of IUGONET
- Data Analysis Software for visualizing and analyzing various data in an integrated fashion

Metadata Database



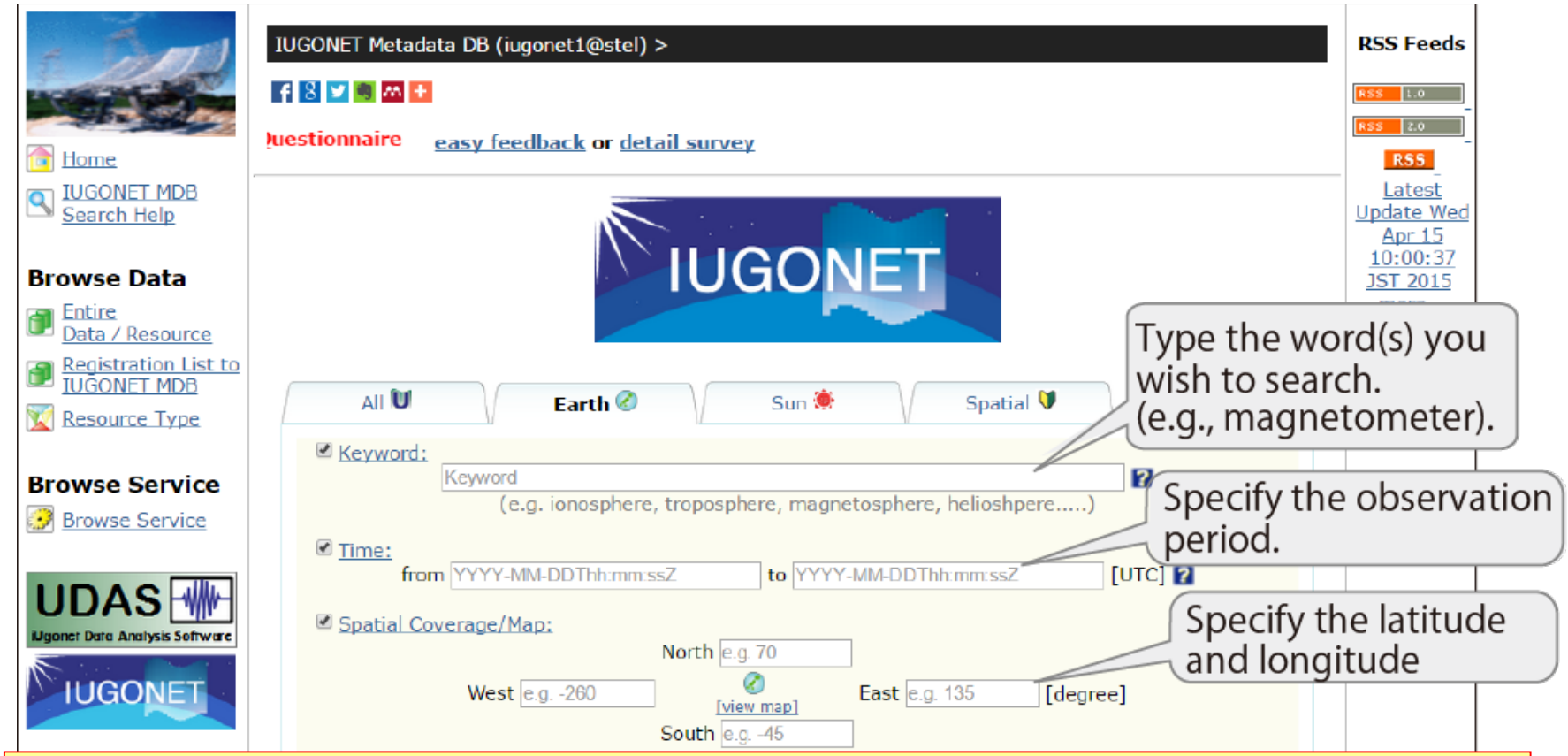
http://search.iugonet.org/iugonet

Data Analysis Software



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

IUGONET Metadata Database

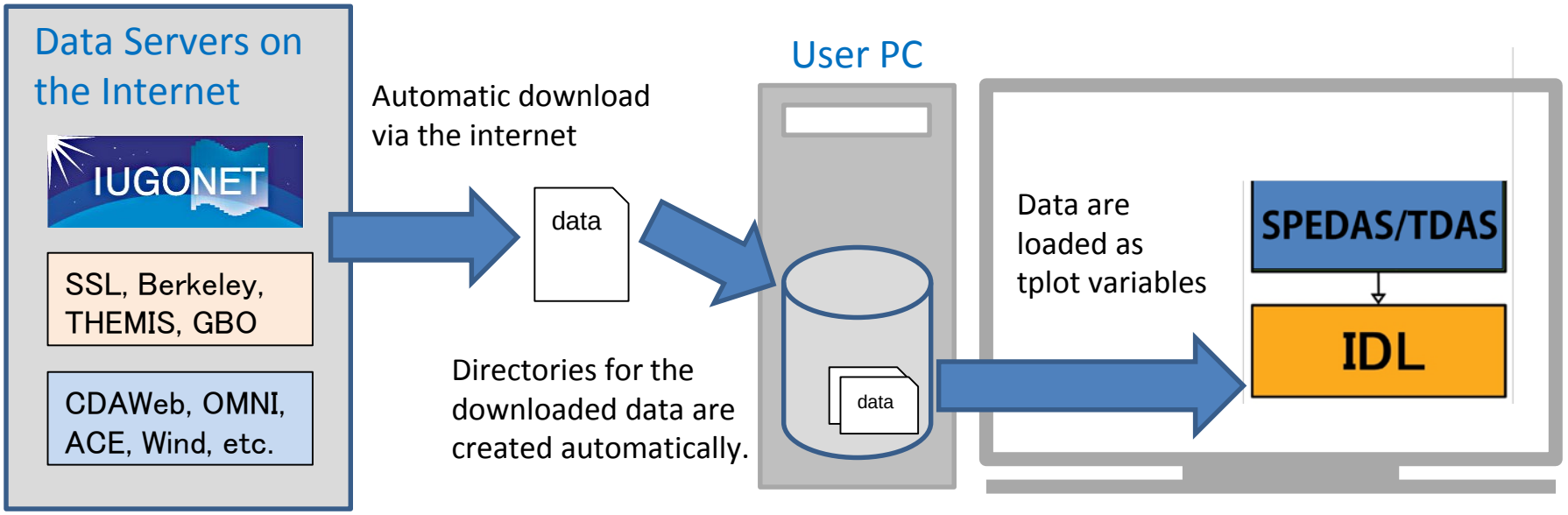


- The IUGONET common metadata format was created on the basis of the Space Physics Archive Search and Extract (spase) format.
- The IUGONET-MDB is a modified system based on DSpace, an open-source software that creates open digital repositories.
- It has OpenSearch interface for sharing the search results 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	timespan, 'yyyy-mm-dd'
2. Load *** data	iug_load_***
3. Plot the loaded data	tplot, +++

Contribution of IUGONET to SPEDAS

Data supported by SPEDAS

Satellite data

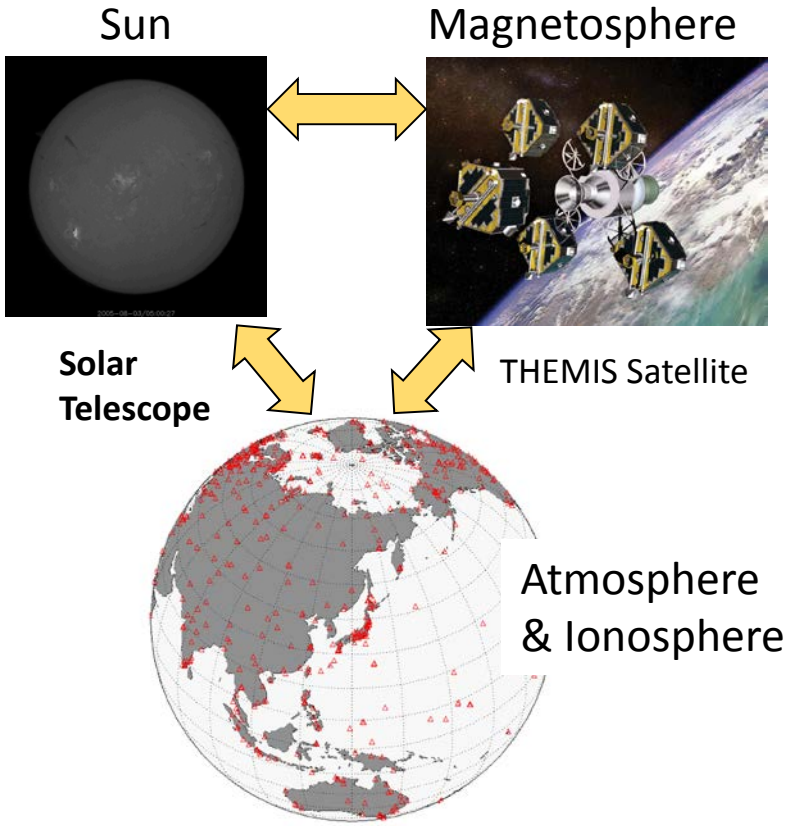
Stereo	SOHO	Wind	ACE	IMP-8	VAP Satellite EFW RBSPICE
THEMIS Satellite	GOES	LANL	NASA OMNI	**ERG**	

Ground-based observational data

THEMIS Geomag.	THEMIS Camera
CARISMA Geomag.	GIMA Geomag.
Greenland Geomag.	MACCS Geomag.
USGS Geomag.	

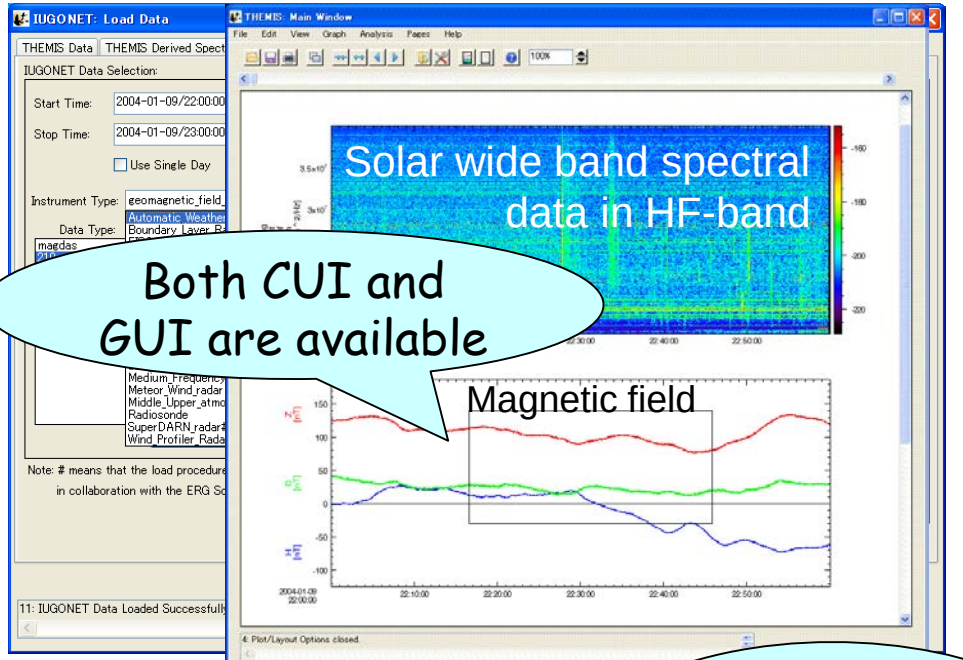
IUGONET, ERG

Solar Telescope, Solar and planetary radio telescope, Ionosphere radar (SuperDARN, EISCAT, etc.), Atmosphere radar (MU, EAR, etc.), Meteorological observation data, Geomag. network（WDC, MAGDAS, 210MM, Antarctica・Iceland, etc.）

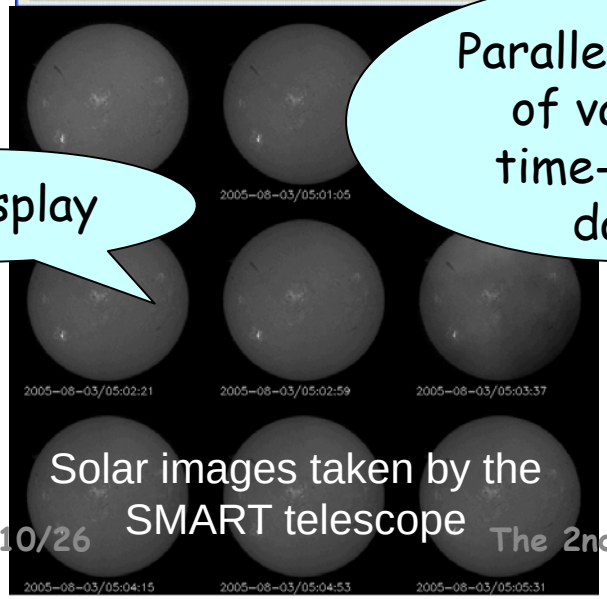


- ✓ Many missions have provided plugins for SPEDAS.
- ✓ IUGONET has also provided a plugin for SPEDAS, which includes many routines for loading various ground-based observation data.
- ✓ SPEDAS is suitable for interdisciplinary study of the upper atmosphere.

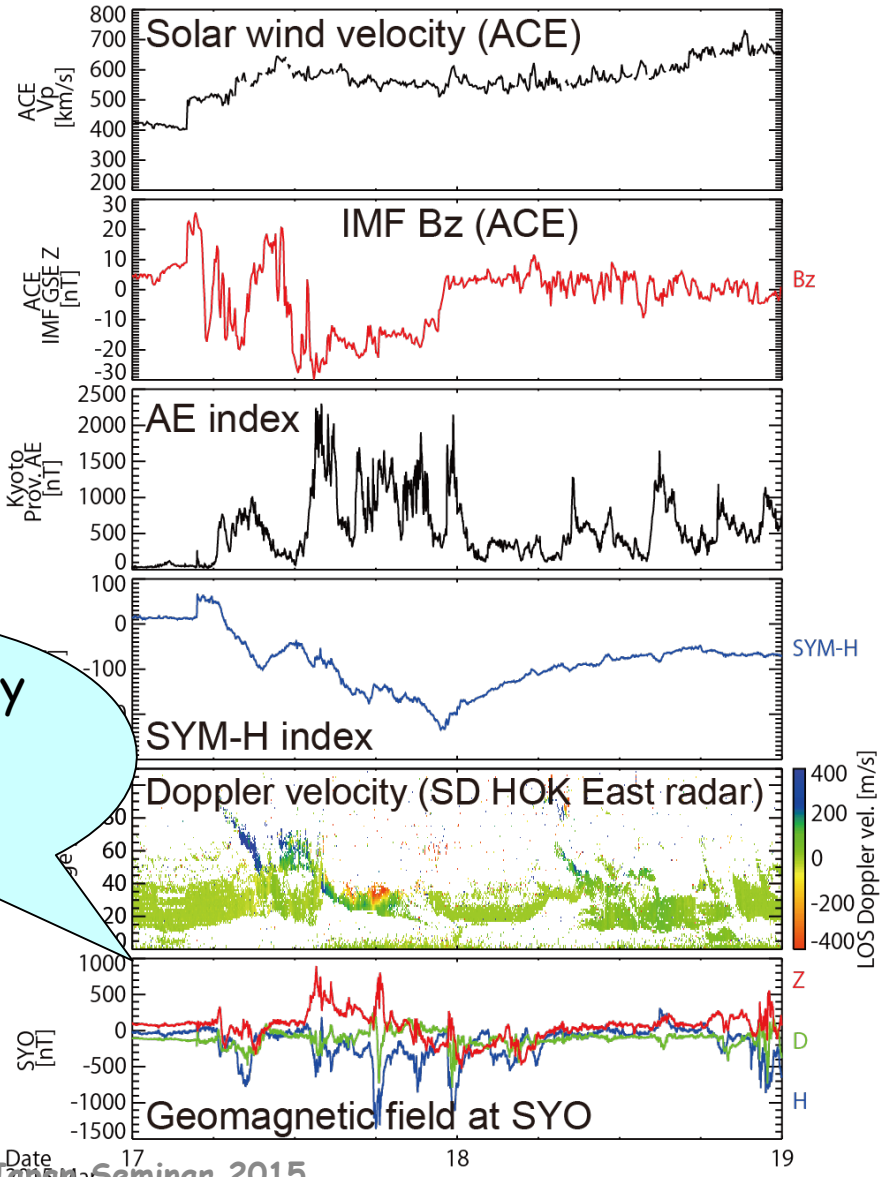
Examples of plots by using SPEDAS



Both CUI and GUI are available



2D display



Parallel display of various time-series data

Collaboration with other projects/institutions

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,…)

ICSU International Council for Science

ICSU WORLD DATA SYSTEM

CODATA

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

Japan Geoscience Union

SGEPSS

IUGONET welcomes any type of support and feedback from users!

Summary

- 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.