IUGONET

Inter-university Upper atmosphere Global Observation NETwork

Metadata DB for Upper Atmosphere

Inter-university Upper atmosphere Global Observation NETwork (IUGONET)

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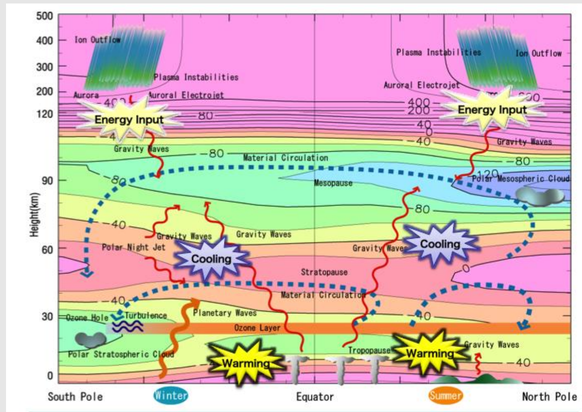
The IUGONET project - objectives

- **Since exchanges of materials, momenta, and energies in the upper atmosphere take place through complicated physical processes at different layers, integrated analysis by using various kinds of observational data is essential for investigating the mechanism of long-term variations in the upper atmosphere.**
- **However, the databases of such observations have been managed and maintained by each institution that conducted the observations. The data have been used by only a very few researchers who were involved in the observation campaign. There is no way to cross-search these databases due to lack of information on the data.**
- **The purpose of this project is to build a metadata database (MDB) of the upper atmospheric data acquired by ground-based observations, and then to promote effective use of the observational data spread across universities and institutes, which will lead to new interdisciplinary, comprehensive studies regarding the upper atmosphere**

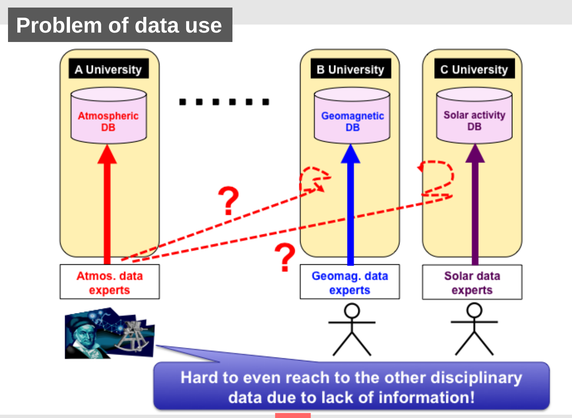


Global Warming in the Troposphere, Cooling in the Upper-Atmosphere, Energy Input with Aurora in the Polar Regions

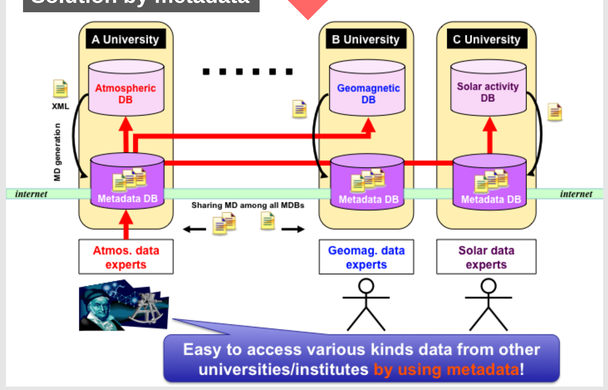
Detection of Fine Signals of Climate Change and Quantification of Global Atmospheric Variation from Global Observations Network by IUGONET

Contribution to Predictions of Global Environment and Climate Change

Problem of data use



Solution by metadata



Project timeline

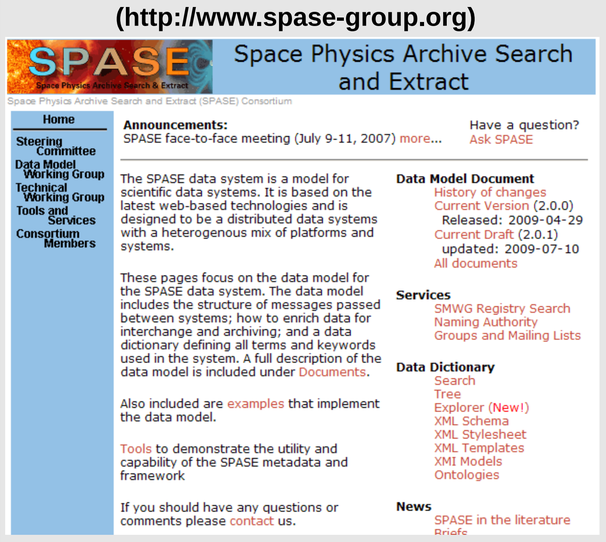
Task	Y2009	Y2010	Y2011	Y2012	Y2013	Y2014	Detail
Virtual information center (VIC) of UA studies	System installation	Normal operation		System update			Construct the integrated research environment (TV-conference system, ..)
Development of metadata DB system	Prototype system devel.	Regular system devel.	Open to public				Design and develop the metadata DB system
Design the Metadata format standards	Ver.1 format	Update & document					Release the format ver.1 and keep updating if necessary
Development of data analysis software	Specifications and basic design	Programming	Open to public				Develop and release analysis softwares for UA data
Maintenance&extension of existing DBs of Observation data		Maintenance of obs. DBs & exam. of non-digital dataset		Effort focused on old data from Y2012 on			Incorporate non-DB'd data into the DBs
Metadata generation		Collecting metdata from each obs. DB		Effort focused on old data from Y2012 on			Generate metadata in the designated format and add to metadata DB
Operation of metadata DB							Release the metadata DB for community
VIC extension to related fields							Wrap up the project and discuss further extension

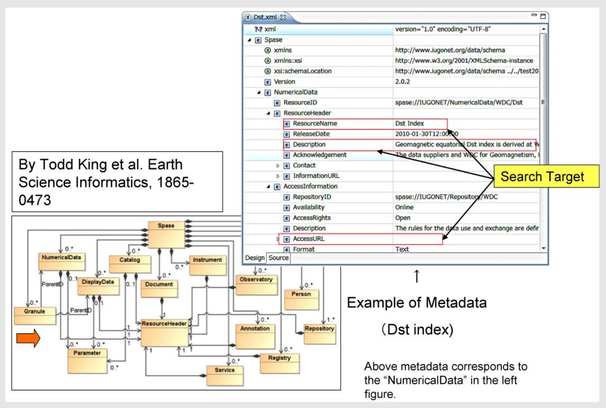
- **Through frequent discussions online, the IUGONET common metadata format has been designed, and our MDB system and data analysis software are now in process of being developed.**

Metadata format

IUGONET common metadata format = SPASE + modifications

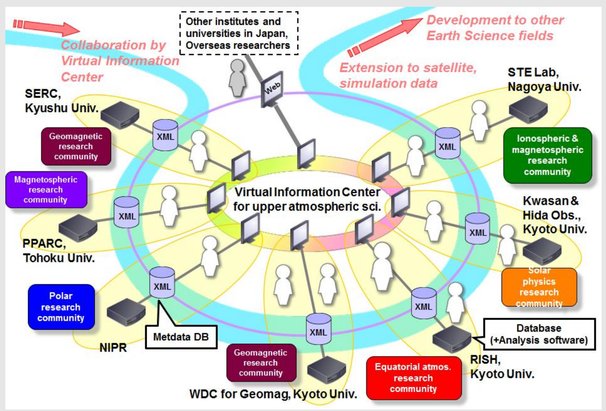
(http://www.spase-group.org)

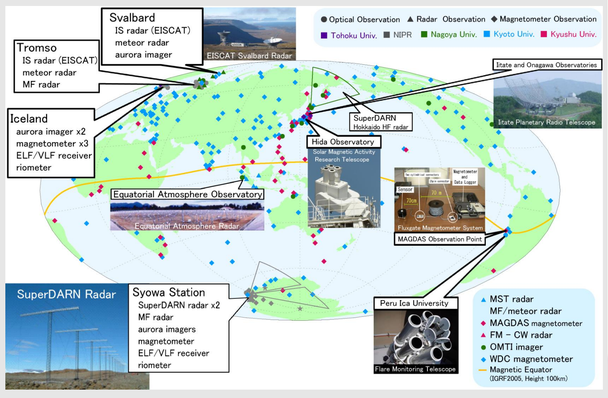




- **We investigated widely-used metadata formats in various scientific fields in the course of the development of the IUGONET common metadata format [1]. Among them we selected the SPASE data model/metadata format [2] as the base of our metadata format since it matches best the upper atmospheric data and holds expandability to fit any kinds of observational data.**
- **A few modifications according to characteristics of our observational data have been added.**
  - ***Additional words to represent non-digital archives***
  - ***Additional words to represent heliospheric coordinates***
  - ***New metadata elements to describe observation location and range***

Inter-university collaboration





- **A six-year research project, Inter-university Upper atmosphere Global Observation NETwork (IUGONET), was launched in 2009 by the five Japanese universities and institutes (NIPR, Tohoku Univ., Nagoya Univ., Kyoto Univ., and Kyushu Univ.) that have been leading ground-based observations of the upper atmosphere for decades.**
- **The MDB will be of great help to researchers in efficiently finding and obtaining various kinds of observational data we have obtained for many years by the global network of radars, magnetometers, optical sensors, helioscopes, and so on.**

IUGONET metadata archiving

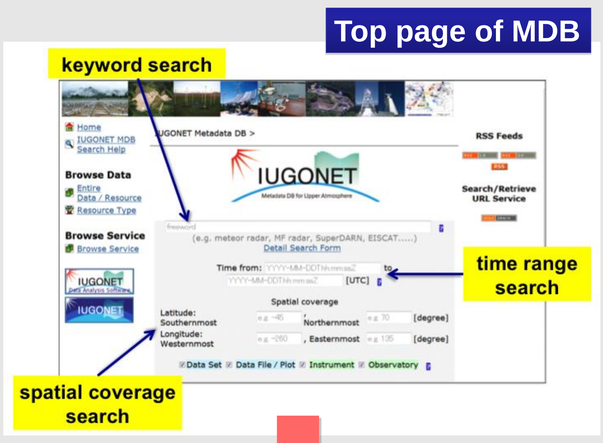
- Tohoku Univ.
  - Geomagnetic data: PC3 index, Onagawa fluxgate and search coil magnetometers
  - HF-band radio wave data: Jupiter radio wave, Sun/Jupiter wide band radio wave
  - VHF-band: Jupiter radio spectral data, Solar radio spectral data
  - LF-band: Standard radio wave phase-amplitude variation data
- National Institute of Polar Research
  - Syowa Station (Antarctica): Aurora camera, magnetometers, Upper Atmos. Physics Monitoring Obs., Imaging Riometer, 1-100Hz ULF/ELF Electromagnetic wave, Fabry-Perot Imager, SuperDARN HF radar, MF radar, Unmanned magnetometer network, Sodium Lidar
  - Upper Atmosphere Physics Obs. at Zhongshan Station, All-skyimager at South Pole station
  - Conjugate Obs. at Iceland: fluxgate/induction magnetometer, Imaging riometer, EISCAT radar, NIPR/Norway Svalbard meteor radar, Tromso meteor radar, Auroral and Airglow obs. at Svalbard and Tromso
- Solar-Terrestrial Environment Lab., Nagoya Univ.
  - NO,NO2,NOx,O3 density, Aerosol chemical composition, Aerosol extinction coefficient, Database of variation of atmospsheric constituents derived by ground spectroscopy obs.
  - Ground magnetometers, Airglow and aurora image by All-sky camera, Thermospheric wind speed scintillation, GPS-TEC, GPS scintillation, VHF radar, EISCAT radar, Optical/MF radar/Meteor radar data at Norway
  - Spatial profile of solar wind velocity by interplanetary Scintillation (IPS)
  - SuperDARN Hokkaido HF radar data
- Kwasan and Hida Observatories, Kyoto Univ.
  - FMT: Event-list, Movies of outstanding events, Real-time images, Digital raw data
  - SMART: Hα full-disk solar images, Hα partial images, Hα real-time images, event catalog, movies, full-disk magnetoram
  - DST: Hα partial solar QL images, Hα partial images, Spectrograph QL images, Spectrograph data
- WDC/Kyoto, Kyoto Univ.
  - Geomagnetic indices(final,provisional,quick look) ← AE, SYM/ASY, Geomagnetic field digital data(WDC final,WDC prompt), Geomagnetic field analog data
  - Geomagnetic field digital data and Barometer data (Original obs. by WDC for Geomag, Kyoto)
  - Geomagnetic field model(IGRF), Ionospheric conductivity model (IRI2007)
  - Catalogue for archived geomagnetic field data
- Research Institute for Sustainable Humanosphere, Kyoto Univ.
  - Shigaraki MU Observatory: MU radar(standard tropospheric obs. Mode, standard mesospheric obs. Mode, standard ionospheric obs. Mode, secial obs.: Meteor/RASS/FAI), Ionosonde, Radiosonde, Boundary layer radar, L-band lower Tropospheric radar, Lower Thermosphere profiler radar, Ceilometer, AWS
  - Equatorial Atmosphere Observatory: EAR(standard tropospheric/ionospheric obs.), Boundary layer radar, X-band weather radar, Ceilometer, Radiosonde
  - Other sites: Pontianak MF radar, Pameungpeuk MF radar, Jakarta meteor radar, Kototabang meteor radar, Jakarta boundary layer radar, Darwin radiosonde (DAW,GDP,KHC) (campaign obs.), Serpong boundary layer/Meteor radar
- Space Environment Research Center, Kyushu Univ.
  - Ground magnetometers(MAGDAS, CPMN)
  - FM-CW radar
  - Geomagnetic Pc5 Index, EE Index

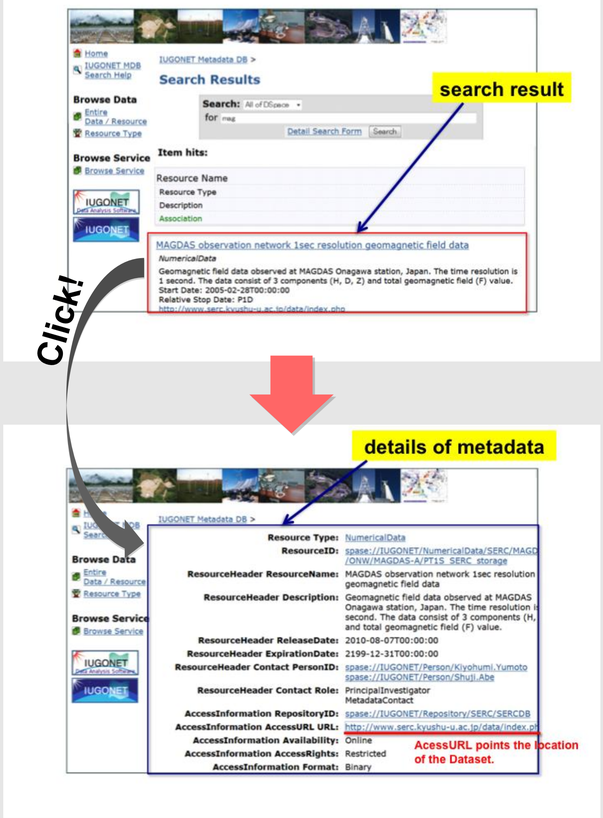
Underlined red:	all metadata for data set were archived
Red:	partially made
black:	in preparation

American Geophysical Union Fall Meeting 2010
San Francisco, California, USA
Dec 13th – 17th, 2010

Development of MDB system

Top page of MDB



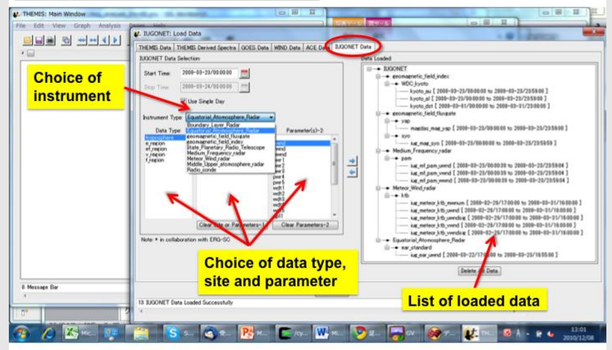


- We adopted **DSpace** as the IUGONET MDB platform. DSpace is a free software widely used by digital repositories in many universities over the world. We can find so many case examples using Dspace. It matches the IUGONET project since we need to develop a stable MDB system in a short period of time.
- DSpace consists of PostgreSQL, Tomcat, Lucene, and so on. It can provide fundamental functions of registering, retrieving, providing and harvesting of metadata written in the IUGONET common metadata format.
- Users will be able to access the IUGONET MDB by using any browsers and get information of various kinds of observational data through the metadata registered there. For example, if "AccessURL" is available, they can got to the web site of the data.

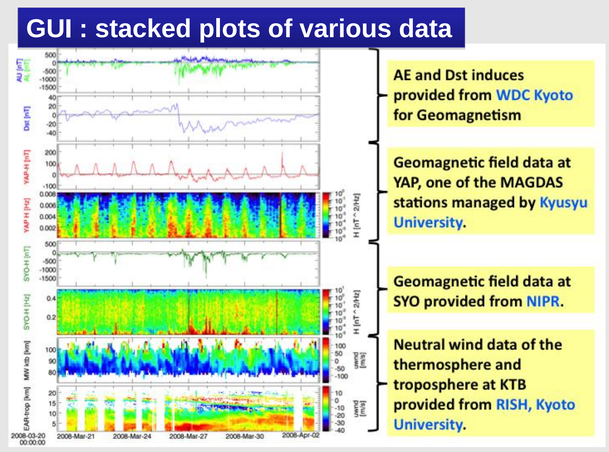
Development of analysis software

IUGONET Data Analysis Software (UDAS)

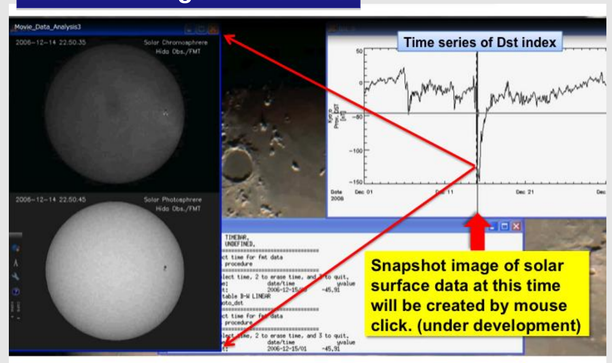
GUI : data load window



GUI : stacked plots of various data



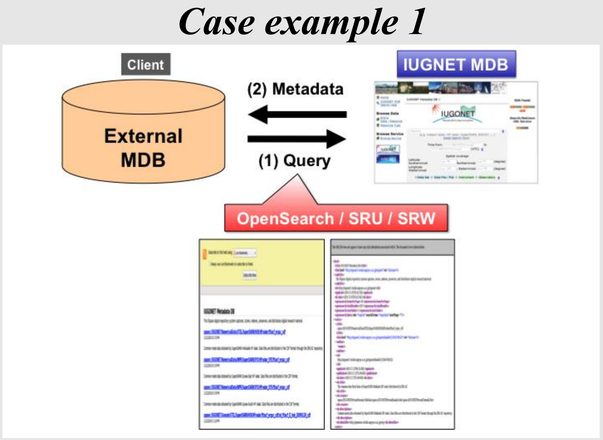
CUI : 2D image with series



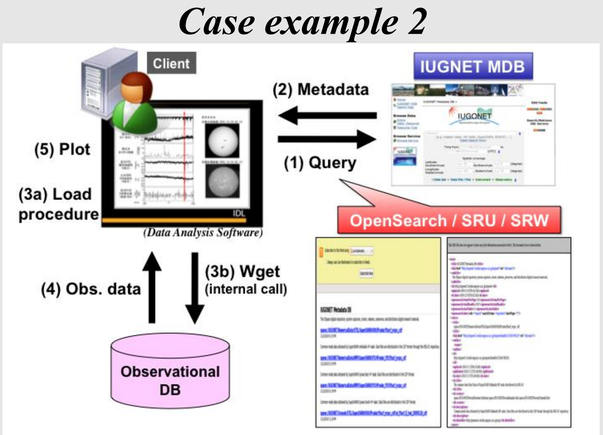
- In addition to the MDB system, the IUGONET project provides a data analysis software to facilitate effective use of our observational data.
- The data analysis software (named UDAS) is written in **IDL** (Interactive Data Language), which is widely used in the fields of solar and terrestrial physics. We are developing the software on the basis of **TDAS** (THEMIS Data Analysis Software suite). The IDL routines of TDAS enable users to easily download, visualize, and analyze various kinds of time series data.
- The UDAS will provide both the GUI (Graphical User Interface) and the CUI (Character User Interface). By using GUI, even beginners will be able to utilize its functions. order to enable even beginners to utilize its functions.
- Our software development is conducted in collaboration with the ERG (Energization and Radiation in Geospace) mission since TDAS is also adopted as their analysis software.

Interface for cross-searching MDB

Case example 1



Case example 2



- The IUGONET project will prepare an interface for arbitrary software to cross-search our MDB.

  case example 1:
  cross-searching from external DBs

  case example 2:
  cross-searching from external data analysis software

- The API is soon to be determined.

Summary

- The IUGONET project builds e-infrastructure (metadata database and analysis software) to promote effective use of upper atmospheric data by ground-based observations.
- Current development status:
  - *The initial version of IUGONET common metadata format was designed based on SPASE.*
  - *The IUGONET MDB system is being built on the basis of DSpace.*
  - *The development of IUGONET analysis software (UDAS) is in progress by using TDAS.*
- The IUGONET products will be beta-released in April or May in 2011.

*** For further information on IUGONET, please visit our web site at http://www.iugonet.org/en**

Acknowledgment

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References

[1] Hori, T. et al., Metadata format utilized for the IUGONET metadata database, MGI015-02, JpGU 2010.

[2] SPASE 2.0: a standard data model for space physics, Todd King, James Thieman and D. Aaron Roberts, Earth Science Informatics, 1865-0473.