



| Title       | Metadata database and data analysis software for the ground-<br>based upper atmospheric data developed by the IUGONET<br>project ja   |  |  |  |
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Metadata DB for Upper Atmosphere

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

# SM21A-1990 Metadata database and data analysis software for the ground-based upper atmospheric data developed by the IUGONET project

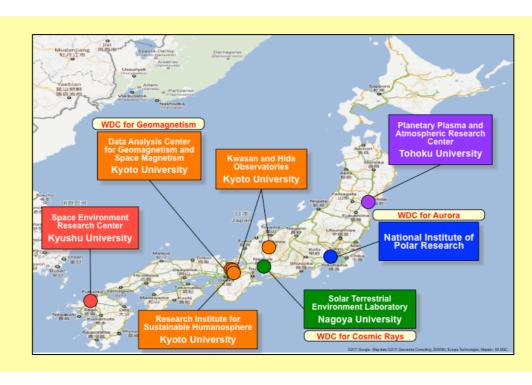
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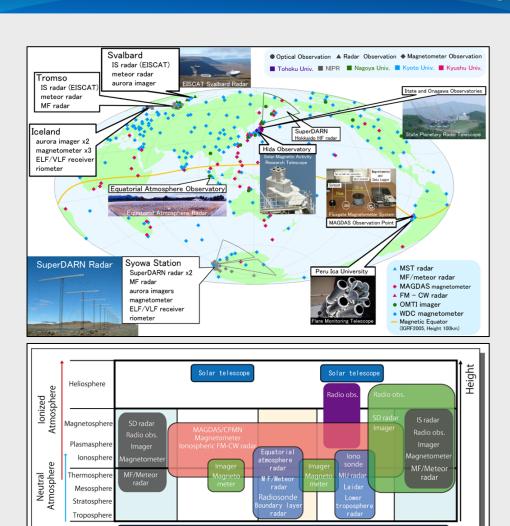




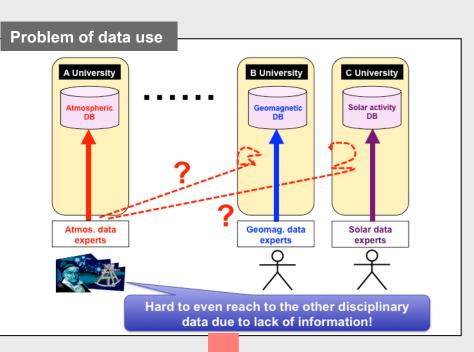


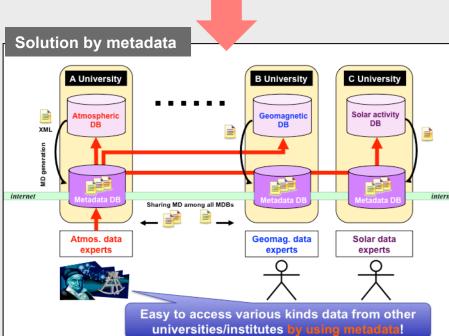
The Inter-university Upper atmosphere Global Observation NETwork (IUGONET) is a Japanese inter-university project by the National Institute of Polar Research (NIPR), Tohoku University, Nagoya University, Kyoto University, and Kyushu University to build a database of metadata for ground-based observations of the upper atmosphere. The IUGONET institutes/universities have been collecting various types of data by radars, magnetometers, photometers, radio telescopes, helioscopes, etc. at various locations all over the world and at various altitude layers from the Earth's surface to the Sun. The metadata database will be of great help to researchers in efficiently finding and obtaining these observational data spread over the institutes/universities. This should also facilitate synthetic analysis of multi-disciplinary data, which will lead to new types of research in the upper atmosphere. The project has also been developing a software to help researchers download, visualize, and analyze the data provided from the **IUGONET** institutes/universities.

## **IUGONET** project



- The IUGONET universities/ institutes have been leading ground-based observations of the upper atmosphere for decades.
- We have various kinds of observational data acquired so far by global observation networks ofradars, magnetometers, photometers, radio telescopes, helioscopes, etc.
- Our observations cover all over the world and wide altitude range from the Earth's surface up to the Sun's surface.





- The databases of these ground based observations, however, have been managed and maintained by each university/institute that conducted the observation. It is often the case that the data have been used by only a very few researchers who were involved in the observation campaign. There is no way for general, potential users to find out these databases due to lack of information.
- The IUGONET project aims at building a metadata database of the upper atmospheric data acquired by ground-based observations so that people can obtain information of various data from the metadata database. This will promote effective use of the observational data spread across universities and institutes, and then lead to new interdisciplinary, comprehensive studies regarding the upper atmosphere.

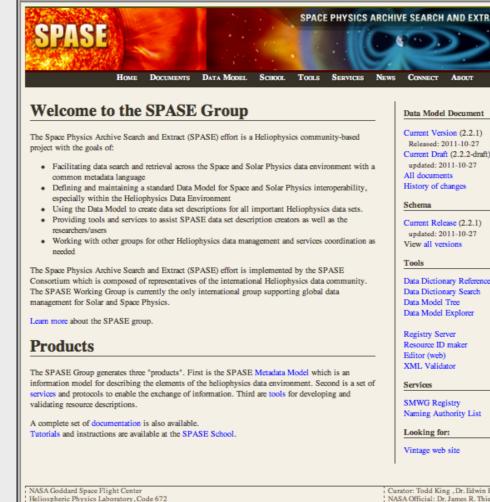
#### The IUGONET started in FY2009 as a 6 year mission. For this fiscal year (FY2011) we plan to release the metadata database online to the public, along with data analysis software to handle our observational data.

|                               | ITEMS   | FY2009                 | FY2010   | FY201                            | 1    | FY2012                 | FY2013                | FY2014            | REMARKS   |  |  |  |
|-------------------------------|---|------------------------|--|----------------------------------|------|------------------------|-----------------------|-------------------|---|--|--|--|
| Virtual Information<br>Center | Installation & stable operation                   | Install system         |  |                                  | L    | Update system          |                       | $\longrightarrow$ | Construct the integrated research environment (video and/or web conference system, etc.)  |  |  |  |
|                               | Extension to other disciplines                    |                        |  |                                  |      |                        |                       | <b>→</b>          | Wrap up the project and discuss further extension of the system to other discipline   |  |  |  |
| Metadata DB<br>system         | Development                                       | Make prototype         | Develop regular<br>system                                    | Release produc<br>public         | t to |                        |                       |                   | Design and build the IUGONET metadata DB system on the basis of DSpace  |  |  |  |
|                               | Stable operation                                  |                        |  |                                  |      | Update computers       |                       | <b>→</b>          | Conduct regular operation of the metadata DB and customize it as needed   |  |  |  |
| Metadata                      | Design of metadata format                         | Release ver.1 format   | Prepare documents  |                                  |      | Update form            | at as needed          | >                 | Formulate the IUGONET common metadata format and keep updating it if necessary  |  |  |  |
|                               | Creation of metadata                              |                        |  | Open metadata<br>thru metadata D |      | Target relat           | ively old, undatabase | d items           | Create metadata in the designated format and register them in the metadata DB system  |  |  |  |
| Analysis Software             | Survey &<br>Specification of<br>analysis software | Specification          | Prepare<br>documents   |                                  |      |                        |                       | ,                 | Design an integrated analysis<br>software to download, visualize,<br>and analyze data provided from<br>the IUGONET institutions |  |  |  |
|                               | Programming                                       |                        |  | Release produc<br>public         | t to | Target relat           | ively old, undatabase | d items           | Develop the IUGONET analysis software by using TDAS (a set of IDL subroutines)  |  |  |  |
| Others                        | Rearrangement of observational DBs                |                        | Rearrange DBs corresponding to metadata & software developme |                                  |      |                        |                       |                   | Rearrange existing observational DBs and newly compile DBs of undatabsed items  |  |  |  |
|                               | Scientific researches                             |                        |  | Co                               | ndu  | ct scientific research | es with the IUGONET   | products          | Do interdisciplinary researches using various data from the IUGONET institutions  |  |  |  |
|                               | Management of project website                     | Build project homepage |  |                                  |      |                        |                       |                   | Provide project information to the public through the website   |  |  |  |
|                               | Today   |                        |  |                                  |      |                        |                       |                   |   |  |  |  |

#### Metadata format

#### **IUGONET** common metadata format = SPASE + modifications

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



http://www.iugonet.org/data/schema ../../to spase://IUGONET/NumericalData/WDC/Ds By Todd King et al. Earth Science Informatics, 1865-The rules for the data use and exchange are defir Example of Metadata

(Dst index)

Above metadata corresponds to

the "NumericalData" in the left

- The IUGONET development team investigated widely-used metadata formats in the Earth and planetary sciences in the course of the development of the **IUGONET** common metadata format. Among them we selected SPASE data model/metadata format as the base of our metadata format because 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 groundbased observational data, have
- > Additional words to represent non-digital Additional words to represent
- heliospheric coordinates New metadata elements to describe observation location and coverage
- The current version of the **IUGONET Common Metadata** Format is 1.0.3 and its XML schema is available at http:// www.iugonet.org/data/schema/.

# Datasets to be registered

#### 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

#### lational Institute of Polar Research

•LF-band: Standard radio wave phase-amplitude variation data

•Syowa Station (Antarctica): Aurora camera, magnetometers. Upper Atmos. Physics Monitoring Obs., Imaging Riometer, 1-100Hz ULF/ELF Electromagnetic wave, Fabry-Perot mager, <u>SuperDARN HF radar</u>, <u>MF radar</u>, <u>Unmanned magnetometer network</u>, <u>Sodium</u>

•Upper Atmosphere Physics Obs. at Zhongshan Station, All-skyimager at South Pole Conjugate Obs. at Iceland: EISCAT radar, NIPR/Norway Svalbard meteor radar, Tromso

Solar-Terrestrial Environment Lab., Nagoya Univ

●NO,NO2,NOx,O3 density, Aerosol chemical composition, Aerosol extinction coefficient, Database of variation of atmosphseric constituents derived by ground spectroscopy obs. , Thermospheric wind speed scintillation, VHF radar, EISCAT radar, Optical/MF

 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: <u>Hα full-disk solar images</u>, Hα partial images, Hα real-time images, event •DST: Hα partial solar QL images, Hα partial images, Spectrograph QL images

#### 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

Catalogue for archived geomagnetic field data

#### Research Institute for Sustainable Humanosphere, Kyoto

Shigaraki MU Observatory: MU radar(standard tropospheric obs. Mode. standard RASS/FAI), Ionosonde, Radiosonde, Boundary layer radar, L-band lowe Equatorial Atmosphere Observatory: EAR(standard tropospheric/ionosphere)

obs.). Boundary layer radar, X-band weather radar, Ceilometer, Radiosonde Other sites: Pontianak MF radar, Pameungpeuk MF radar, Jakarta meteor radar, Darwin radiosonde (DAW,GDP,KHC)(campaign obs.)

Space Environment Research Center, Kyushu Univ.

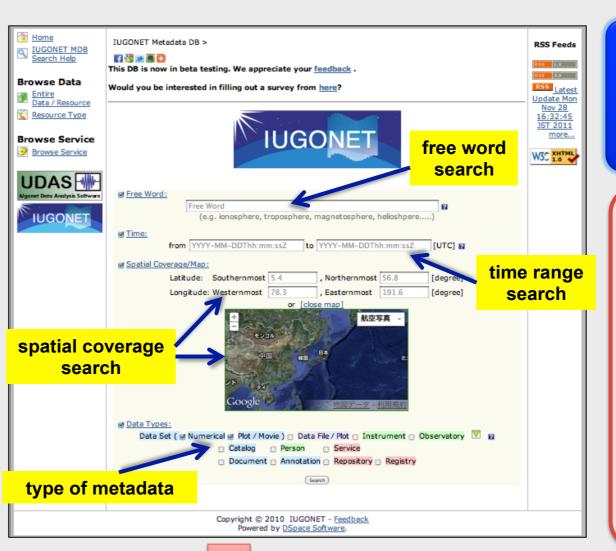
●Geomagnetic Pc5 Index, EE Index, Pi2 Index ●Sq observation & model data

all metadata for dataset have been archived partially done in preparation

Currently 712 metadata files of "Numerical Data" and "Display Data" are registered in the **IUGONET** metadata database. We are now talking with some researchers and research institutes who are interested in registering metadata of their ground-based observations of the upper atmosphere into the IUGONET metadata database. The number of registered metadata will be continuously increasing!

#### Metadata database

The IUGONET metadata database has been released for beta testing! It is now available at http://search.iugonet.org/iugonet/.

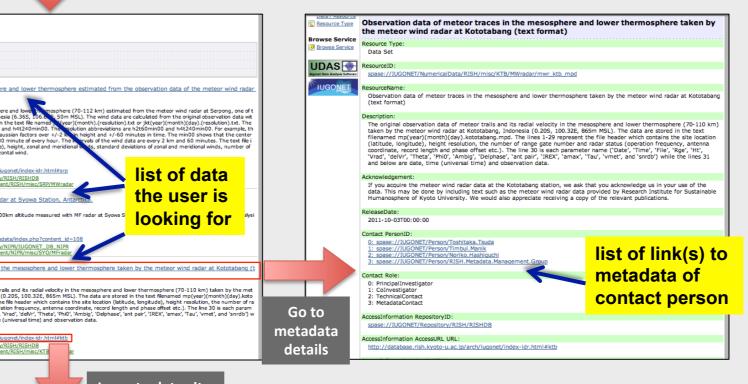


Show result of

data search

#### # of metadata registered (as of Dec. 1<sup>st</sup>, 2011) 1,259,921 (\* including "Granule")

- The IUGONET project adopted **DSpace** as the metadata database platform. DSpace is a free software widely used by digital repositories at many universities over the world.
- DSpace consists of PostgreSQL Tomcat, Lucene, and so on. It can provide fundamental functions of registering, retrieving, providing and harvesting of metadata written even in the IUGONET common metadata format.

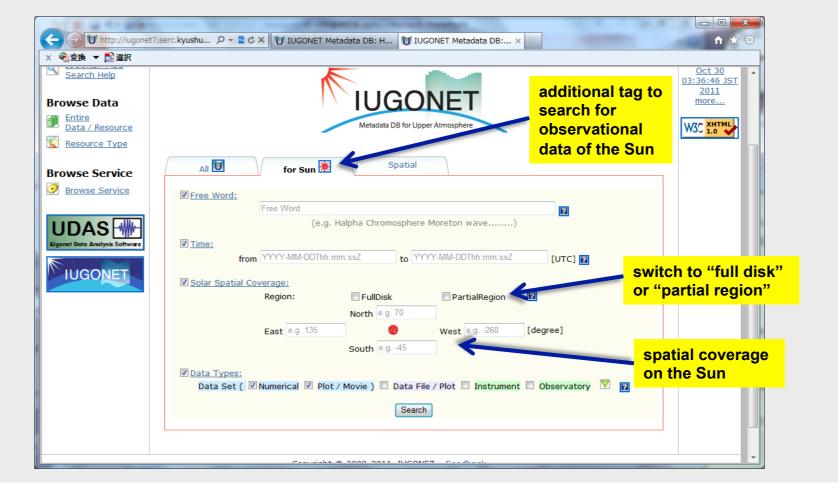


# Jump to data site riginal observation data of meteor traces (text format 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 izontal wind data estimated from the observation data (text [Description] The wind data are calculated from the original observation data with a weighting function. They are stored in the text file named Wk(year)(month), (resolution),txt. or Wk(year)(month)(day),(resolution),txt. The resolution abbreviations are h2t60min00, h2t60min30, h4t60min00 and h4t60min30. For example, the h2t60 means weighted average with Gaussian factors over +/-2 km in height and +/-60 minutes in time. The min00 shows that the center of the Gaussian window corresponds to 00 minute of every hour. The intervals of the wind data are every 2 km and 60 minutes. If you want to know more information of this data, please refer to the readme file (English, Japanese) and access the metadata.

- The "search result" shows part of metadata title, description, and access URL if available of data that match input keyword(s), time range, and spatial coverage.
- The metadata "title" is a link to the metadata details which include at least link(s) to metadata of contact person responsible to the
- The "access URL" leads the user to the web site of the observational database. The user may be able to obtain the data files if they are available

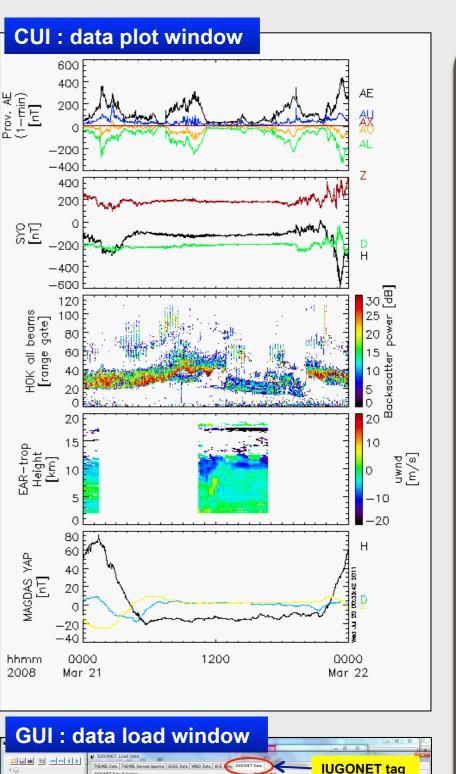
#### Currently under development ...

Since metadata of observations of the Sun's surface from the IUGONET universities/institutes and collaborators are expected to be increased, we are now developing a new interface of the IUGONET metadata database. It will be available with some other modifications in early 2012!



### **Analysis software (UDAS)**

The beta version of the IUGONET data analysis software, named UDAS (currently version 1.00b3), can be downloaded from the project website at http://www.iugonet.org/en/software.html.



• The 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 UDAS is distributed as a plug-in

software of TDAS to handle data provided

from the IUGONET universities/institutes.

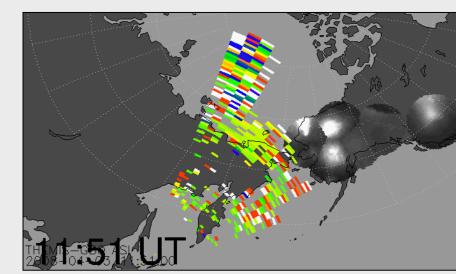
- The TDAS already contains a lot of useful functions to enable users to download, visualize, and analyze various kinds of data. It is easy to make stacked plots of time series in order to compare various kind of data at one time.
- The UDAS accesses IUGONET data through the internet, and then the data are automatically downloaded onto the user's computer. Users can get and analyze the data without knowing data file locations.
- Users don't have to take care of data formats when analyzing the data. The data downloaded and plots created can be exported to a variety of data format (ASCII, PNG, JPEG, PS, EPS, etc.).
- GUI (Graphical User Interface) as well as **CUI (Character User Interface) is available** so that even users who are not familiar with the data can visualize and analyze them.

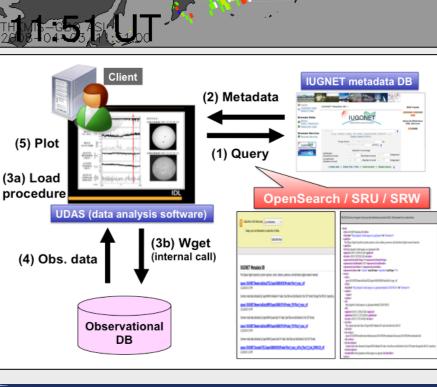
#### Currently under development ...

choice of data parameters, etc.

choice of

dataset





- IDL Virtual Machine (VM)
  - The IDL Virtual Machine is a freely distributed, cross-platform utility for running compiled IDL codes. We are collaborating with the THEMIS Science Support Team to distribute complied IDL codes of the data analysis software.
- IDL load procedures for 2D images
- The IUGONET universities/institutes archive a lot of 2D images (e.g. Sun's surface, Aurora, etc.). Therefore, we are trying to develop IDL programs with TDAS to easily make plots of those images.
- IDL programs to get information from the IUGONET metadata DB
- Currently the URLs of data to be downloaded are directly hardcoded into the UDAS's load procedures. We are testing how to get URLs of data and other information from the IUGONET metadata database.

# Acknowlegement

- This project is supported by the Special Educational Research Budget (Research Promotion) [FY2009] and the Special Budget (Project) [FY2010 and later years] from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.
- We acknowledge the cooperation and generosity of the THEMIS Science Support Team in allowing us to use TDAS for our data analysis software (UDAS).
- The UDAS has been developed in collaboration with the ERG (Energization and Radiation in Geospace) Science Center.
- SuperDARN KSR radar data was provided by the National Institute of Information and Communications Technology (NICT) through ERG-SC. The IDL load procedure for the data in UDAS was developed in collaboration with NICT.