<table>
<thead>
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<tr>
<td>Author(s)</td>
<td>HAYASHI, Hiroo; KOYAMA, Yukinobu; HORI, Tomoaki; TANAKA, Yoshimasa; KAGITANI, Masato; SHINBORI, Atsuki; ABE, Shuji; KOUNO, Takahisa; YOSHIDA, Daiki; UENO, Satoru; KANEDA, Naoki; IUGONET project team</td>
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<tr>
<td>Citation</td>
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<td>Issue Date</td>
<td>2011-03-29</td>
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<td>This is not the published version. Please cite only the published version. この論文は出版社版でありません。引用の際には出版社版をご確認ご利用ください。</td>
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<td>Presentation</td>
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Kyoto University
Introduction to a metadata database developed by the Inter–university Upper atmosphere Global Observation NETwork (IUGONET) project

The IUGONET project aims at building “e-infrastructure” for researchers to effectively find, get, and analyze various kinds of upper atmospheric data spread over universities and institutes.

- Distributes ground-based observational data accumulated over 50 years since IGY (both digital and analogue data)
- Promotes analyses of multi-disciplinary data, which will lead to comprehensive studies of mechanisms of long-term variations in the upper atmosphere

Participating universities and research institutes:

- Planetary Plasma and Atmospheric Research Center, **Tohoku University**
- **National Institute of Polar Research**
- Solar Terrestrial Environment Laboratory, **Nagoya University**
- Research Institute for Sustainable Humanosphere, **Kyoto University**
- World Data Center for Geomagnetism, **Kyoto University**
- Kwasan and Hida Observatories, **Kyoto University**
- Space Environment Research Center, **Kyushu University**
Observations by IUGONET institutions

Various observation parameters (temperature, wind, geomagnetism, aurora, etc.) taken by various observation techniques at various locations and altitudes

Such observational data not necessarily well used in scientific researches so far

→ What’s the problem?
Problem with databases

Hard to even reach to the other disciplinary data due to lack of information!
Database access through metadata DB

- Observation time
  ex) 2011-03-29 07:30:00
- Observation location
  ex) 34.85N, 135.10E
- Instrument type
  ex) VHF radar
- Location of data file
  ex) www.rish.kyoto-u...
- Contact
  ex) hhayashi@rish...
- ... etc.

Easy to access various kinds of data from other disciplines by using metadata!
Virtual Information Center
Installation & Operation
FY2009: Install system
FY2010: Update system
FY2011: Construct the integrated research environment (video and/or web conference system, etc.)
FY2012: Wrap up the project and discuss further extension of the system to other discipline

Metadata DB system
Development
FY2009: Make prototype
FY2010: Develop regular system
FY2011: Open metadata DB to public
FY2012: Design and build the IUGONET metadata DB system on the basis of DSpace
FY2013: Conduct regular operation of the metadata DB and customize it as needed
FY2014: Formulate the IUGONET common metadata format and keep updating it if necessary

Metadata Operation
FY2009: Release ver.1 format
FY2010: Prepare documents
FY2011: Update format as needed
FY2012: Target relatively old, undatabased items
FY2013: Create metadata in the designated format and register them in the metadata DB system

Survey & Specification of analysis software
FY2009: Specification
FY2010: Prepare documents
FY2011: Open software to public
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FY2013: Design an integrated analysis software to download, visualize, and analyze data provided from the IUGONET institutions

Analysis Software Programming
FY2009: Preparation of software
FY2010: Rearrange DBs corresponding to metadata & software development
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FY2012: Develop the IUGONET analysis software by using TDAS (a set of IDL subroutines)

Rearrangement of observational DBs
FY2009: Rearrange DBs corresponding to metadata & software development
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FY2011: Rearrange existing observational DBs and newly compile DBs of undatabased items

Others Management of project website
FY2009: Build project homepage
FY2010: Provide project information to the public through the website
FY2011: To be beta-released on April 1st!!
FY2012: Target relatively old, undatabased items
FY2013: Rearrange existing observational DBs and newly compile DBs of undatabased items
FY2014: Provide project information to the public through the website
Design of metadata format

- Many metadata formats available in the Earth and planetary sciences!
  - Dublin Core
  - ISO 19115 / 19139
  - GCMD DIF
  - FGDC CSDGM
  - IPY Metadata Profile
  - ISTP Standards
  - SPASE
  - ...

- IUGONET adopted SPASE with some modifications
  - originally developed to describe research resources regarding heliospheric and magnetospheric satellite observations
  - closely related to STP and upper atmospheric researches (.easy to use as a base format)
  - new metadata elements & words appendable (customizable according to our data)
  - widely-used in existing Virtual Observatories (possible metadata exchanges)
Creation of metadata

**EXAMPLE : Metadata of Numerical Data**

<table>
<thead>
<tr>
<th>ResourceID:</th>
<th>space://IUGONET/NumericalData/EAR/RAO/EAR/trop_std_netcdf</th>
</tr>
</thead>
<tbody>
<tr>
<td>ResourceHeader:</td>
<td></td>
</tr>
<tr>
<td>ResourceName:</td>
<td>EAR standard tropospheric observation mode</td>
</tr>
<tr>
<td>ReleaseDate:</td>
<td>2010-04-12</td>
</tr>
<tr>
<td>Description:</td>
<td>Zonal, meridional, vertical winds, beam echo intensity, and spectral width data taken by the EAR operated in the standard …</td>
</tr>
<tr>
<td>Acknowledgement:</td>
<td>If you acquire EAR data, we ask that you acknowledge us in …</td>
</tr>
<tr>
<td>Contact:</td>
<td></td>
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<tr>
<td>PersonID:</td>
<td>space://IUGONET/Person/EAR.Management.Group</td>
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<tr>
<td>Role:</td>
<td>General Contact</td>
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<td>AccessInformation:</td>
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<td>RepositoryID:</td>
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<td>Open</td>
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<tr>
<td>URL:</td>
<td><a href="http://www.rish.kyoto-u.ac.jp/ear/data/index.html">http://www.rish.kyoto-u.ac.jp/ear/data/index.html</a></td>
</tr>
<tr>
<td>Format:</td>
<td>NetCDF</td>
</tr>
</tbody>
</table>

- Metadata of instrument, observatory, person, repository also created
- Each metadata file written in XML format
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-sky imager 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 atmospheric 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 magnetogram
- 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, special 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
IUGONET has been building a metadata DB based on DSpace, a free, repository software widely used by digital repositories in many universities over the world.

IUGONET metadata DB:

http://search.iugonet.org/iugonet/

User ID = iugonet
Password = iugonet
Metadata DB system – search form

- **Keyword search**
- **Time range search**
- **Spatial coverage search**
**Metadata DB system – search result**

<table>
<thead>
<tr>
<th>Document Title</th>
<th>URL</th>
<th>Repository</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>The common time flat cdf data of SuperDARN King Salmon HF radar distributed by ERG-SC</td>
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<td></td>
<td></td>
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<tr>
<td><strong>Numerical Data</strong></td>
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<td>Common mode data obtained by SuperDARN King Salmon HF radar. Data files are distributed in the CDF format through the ERG-SC repository.</td>
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<tr>
<td><strong>Standard observation data of the troposphere and lower stratosphere taken by the MU radar (NetCDF format)</strong></td>
<td></td>
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<tr>
<td><strong>Numerical Data</strong></td>
<td></td>
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<tr>
<td>The 10-minute average observation data in the NetCDF (Network Common Data Form) format taken by the MU radar at Shigaraki in the Shiga prefecture, Japan (34.85N, 136.10E, 385m MSL), which has been operated in the standard observation mode of the troposphere and stratosphere. The observation data are stored in the NetCDF files of each day. The file name is (year)(month)(day).nc. The NetCDF data include range, height, time, three components of wind velocity, radial Doppler velocity, echo power, spectral width and noise level for each beam number and so on. The azimuth and zenith angles of beam 1, 2, 3, 4 and 5 are (0, 0), (0, 10), (90, 10), (180, 10) and (270, 10), respectively, in unit of degree. The value of 1.0e+10 means missing data.</td>
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<td>Repository: spase://IUGONET/Repository/RISH/RISHHDR</td>
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<td><strong>Field-aligned irregularity (FAI) observation data of the ionosphere taken by the EAR (NetCDF format)</strong></td>
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<tr>
<td><strong>Numerical Data</strong></td>
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<tr>
<td>The field-aligned irregularity (FAI) observation data in the NetCDF (Network Common Data Form) format taken by the equatorial atmosphere radar (EAR) at Kototabang, Indonesia (0.205, 100.32E, 865m MSL). This FAI observation mode covers a wide altitude range from 80 to 600 km in the ionosphere (D-region (below 90 km), E-region (90-150 km), and F-region (above 150 km)). The observation data are stored in the NetCDF files of each day and observation parameter. The file name is (year)(month)(day).(observation parameter).nc. The NetCDF data include range, height, time, radial Doppler velocity, echo power, spectral width and noise level for each beam number and so on. Details of the observation parameter are described in the EAR-FAI homepage (<a href="http://www.rish.kyoto-u.ac.jp/ear/data-fai/index.html">http://www.rish.kyoto-u.ac.jp/ear/data-fai/index.html</a>). The value of 1.0e+10 means missing data.</td>
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Metadata DB system – detailed metadata

ResourceName:
Standard observation data of the troposphere and lower stratosphere (in NetCDF format)

Description:
The 10-minute average observation data in the NetCDF (Network Common Data Form) format taken by the MU radar at Shigaraki in the Shiga prefecture, Japan (34.85N, 136.10E, 385m MSL), which has been operated in the standard observation mode of the troposphere and stratosphere. The observation data are stored in the NetCDF files of each day. The file name is (year)(month)(day).nc. The NetCDF data include range, height, time, three components of wind velocity, radial Doppler velocity, echo power, spectral width and noise level for each beam number and so on. The azimuth and zenith angles of beam 1, 2, 3, 4 and 5 are (0, 0), (0, 10), (90, 10), (180, 10) and (270, 10), respectively, in unit of degree. The value of 1.0e+10 means missing data.

Acknowledgement:
If you acquire MU radar data, we ask that you acknowledge us in your use of the data. This may be done by including text such as MU radar data provided by Research Institute for Sustainable Humanosphere of Kyoto University. We would also appreciate receiving a copy of the relevant publications.

ReleaseDate:
2011-03-06T00:00:00

Contact PersonID:
0: spase://IUGONET/Person/Hiroyuki.Hashiguchi
1: spase://IUGONET/Person/MU.Radar.Management.Group
2: spase://IUGONET/Person/Noriko.Hashiguchi
3: spase://IUGONET/Person/Atsuki.Shinbori

Contact Role:
0: PrincipalInvestigator
1: GeneralContact
2: DataProducer
3: MetadataContact

AccessInformation RepositoryID:
spase://IUGONET/Repository/RISH/RISHDB

AccessInformation AccessURL URL:
http://www.rish.kyoto-u.ac.jp/radar-group/mu/data/

AccessInformation Availability:
Online

AccessInformation AccessRights:
Open

AcessURL points the location of dataset you are interested in.
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<td>Survey &amp; Specification of analysis software</td>
<td>Specification</td>
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<tr>
<td><strong>Others</strong></td>
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<td>Rearrange existing observational DBs and newly compile DBs of undatabased items</td>
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</tr>
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<td>Build homepage</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Provide project information to the public through the website</td>
</tr>
</tbody>
</table>

**To be beta-released on April 1st !!**

**To be beta-released in early May !!**

Dr. Shinbori will talk about the IUGONET analysis software
Use of metadata DB by software

Planning to use metadata DB from analysis software to get some info (e.g. URL)

User

Get URL of data

IUGONET metadata DB

Observational DB

(1) Query

(2) Metadata

OpenSearch / SRU / SRW

(5) Plot

(3a) Load procedure

(Data Analysis Software)

(4) Obs. data

(3b) Wget (internal call)
Regional CAWSES-II MLT Radar Workshop
~ Singapore, 8 & 9 March 2010 ~
Asia-oceanian MLT radar network

- **MF radar**
- **Meteor radar**
- **VHF radar**
- **Others**

* Open symbol: suspended or terminated
* Blue colored: planned

Locations:
- **Asia**
  - Trivandrum
  - Tirunelveli
  - Koto Tabang
  - Pontianak
  - Jakarta/Serpong
  - Pameungpeuk
  - Katherine
  - Buckland Park (Adelaide)
- **Australia**
  - Alice Springs
- **Japan**
  - Rikubetsu
  - Shigaraki
  - Mohe
  - Wakkanai
  - Gyeryong
  - Langfang
  - Wuhan
- **China**
  - Beijing
  - Kunming
  - Wuhan
- **India**
  - Trivandrum
  - Trivunveli
  - Kolhapur
  - Kodapa
- **Korea**
  - Gyeongju
- **Indonesia**
  - Pontianak
  - Jakarta/Serpong
- **Vietnam**
  - Sanya
- **Malaysia**
  - Kuala Lumpur
- **Australia**
  - Darwin
  - Geraldton
- **New Zealand**
  - Auckland
- **Australia**
  - Alice Springs

Radar Types:
- **VHF radar**
- **MST radar**
- **Lidar**
- **SuperDARN HF radar**
- **MU radar / Lidar**
- **MF radar**
- **Meteor radar**
- **VHF ST radar / VHF BLT radar**
- **SuperDARN / Lidar**
The IUGONET project builds e-infrastructure (metadata database and analysis software) to promote effective use of upper atmospheric data taken by ground-based observations.

The IUGONET metadata database is scheduled to be beta-released on April 1\textsuperscript{st}, 2011.

The IUGONET metadata database should be used to facilitate data exchange among the Asia-oceanian MLT radar network.