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<tr>
<th>Title</th>
<th>Inter-University Upper Atmosphere Global Observation Network (IUGONET)</th>
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<tr>
<td>Author(s)</td>
<td>Tsuda, Toshitaka; Sato, Natsuo; Fujii, Ryoichi; Ono, Takayuki; Yumoto, Kiyohumi; Iyemori, Toshihiko; Shibata, Kazunari; Hayashi, Hiroo; Hori, Tomoaki; Tanaka, Yoshimasa; Koyama, Yukinobu; Abe, Shuji; Shinbori, Atsuki; Umemura, Norio; Yoneda, Mizuki; Ueno, Satoru; Kaneda, Naoki; IUGONET project team</td>
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Kyoto University
Inter-University Upper Atmosphere Global Observation Network (IUGONET)

While there exist various internal physical processes, the upper atmosphere is strongly influenced by external factors, e.g. energy input from the Sun by ultraviolet radiation and momentum injection from the lower atmosphere by propagating atmospheric waves.

To comprehensively understand the upper atmosphere, multidisciplinary researches are required with combinations of various types of observational data taken at different locations and altitudes.
ICSU ------ Antarctic Research (SCAR)
    |--- Biodiversity (DIVERSITAS)
    |--- Climate Observation (GCOS)
    |--- Climate Research (WCRP)
    |--- **Data for Science & Technology (CODATA)**
    |--- Disaster Risk (IRDR)
    |--- Ecosystem Change & Society (PECS)
    |--- Geosphere-Biosphere (IGBP)
    |--- Human Dimensions of Global Environmental Change (IHDP)
    |--- Ocean Observations (GOOS)
    |--- Ocean Research (SCOR)
    |--- Radio Astronomy & Space Science (IUCAF)
    |--- **Solar-Terrestrial Physics (SCOSTEP)**
        President; Nat Gopalswamy (NASA)
        Vice President; F. J. Luebken, (IAP)
        Bureau from URSI, IAMAS, IAGA, IUPAP, SCAR, COSPAR
    |--- Space Research (COSPAR)
    |--- Terrestrial Observations (GTOS)
    |--- **World Data System (WDS)**
IGY: International Geophysical Year (1957/58)
IQSY: International Quiet Sun Year (1964/65)
IMS: International Magnetospheric Study (1976-79)
MAP: Middle Atmosphere Program (1982-85)
STEP: Solar-Terrestrial Energy Program (1990-95)

Post-STEP sub programs (1998-2002)
S-RAMP: STEP Results, Applications, and Modeling Phase
EPIC: Equatorial Processes Including Coupling
ISCS: International Solar Cycle Study
PSMOS: Planetary Scale Mesopause Observing System

1: 2004-2008
2: 2009-2013

SCOSTEP's international program in 2004-2008 to link the world's scientists in a cooperative effort to enhance our understanding of the Solar Terrestrial relations, which impacts on life and society. In particular, we put special emphasis on the short (weather) and long-term (climate) variability of the solar activities and their effects in geospace and Earth’s environment.

- space missions, ground-based observations, and theory, modeling, and data analysis
- space weather forecasting, design of space- and Earth-based technological systems, and understanding the role of solar-terrestrial influences on global change.

CAWSES Science Steering Group (SSG)
(1) Solar Influence on Climate
(2) Space Weather: Science and Applications
(3) Atmospheric Coupling Processes
(4) Space Climatology
Four Themes under CAWSES

Solar Influence on Climate

Space Weather: Science and Applications

Atmospheric Coupling Processes

Climatology of the Sun-Earth System
For the ground-based observation of the upper atmosphere, huge, various kinds of observational data have been accumulated at universities and institutes since IGY in 1957-58.

These observational data have not been necessarily well used by various researchers.

IUGONET started in FY 2009!
CAESES II

CAWSES II: Towards Solar Maximum, 2009-2013

CAWSES II addresses:

- Fundamental questions of how the coupled sun-earth system operates on timescales of minutes to millenia
- Questions that require coordinated interdisciplinary international effort

Co-Chair of CAWSES-II
2009-10: Susan Avery & Alan Rogers
2011-13: Joe Davila & Toshitaka Tsuda
TG1: Solar influences on climate

TG2: Effect of climate change on geospace

TG3: Solar variability affects on geospace

TG4: Effect of waves on the upper atmosphere

TG5: Capacity building

TG6: E-science and Informatics
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.

- To distribute ground-based observational data accumulated over 50 years since IGY (both digital and analogue data)
- To promote analyses of multi-disciplinary data, which will lead to comprehensive studies of mechanisms of long-term variations in the upper atmosphere
Observational Data Collected by the IUGONET Institutes

Various observation parameters (wind, geomagnetism, aurora, sunspot etc.) taken by various techniques in various time periods at various locations and altitudes.

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

→ What’s the problem?
PROBLEM: Various kind, huge amount of data spread over research institutes with little info.

SOLUTION: Create a metadata database for cross-search of these dispersed data

Promote new types of the upper atmospheric research by the analysis of multidisciplinary data

Create a metadata database of the upper atmospheric data for cross-search

Develop an integrated data analysis software to handle the data from the IUGONET institutes

Strengthen collaboration among institutes/universities in Japan and overseas

Expand this system to satellite and simulation data

Finally to other Earth and planetary science fields ...

Virtual Information Center for upper atmospheric sci.

SERC, Kyushu Univ.

PPARC, Tohoku Univ.

National Institute of Polar Research

DACGSM, Kyoto Univ.

STE Lab, Nagoya Univ.

Kwasan & Hida Observatories, Kyoto Univ.

Ionospheric & magnetospheric research community

Solar physics research community

Equatorial atmosphere research community

Obs. Database + Analysis Software

Metadata DB
# IUGONET Project Timeline

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<td>Virtual Information Center</td>
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<tr>
<td>Installation &amp; stable</td>
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<td>Install system</td>
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<td>operation</td>
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<td>Extension to other disciplines</td>
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<td>Wrap up the project and discuss further extension of the system to other discipline</td>
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<td>Development</td>
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<td>Make prototype</td>
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<td>Release product</td>
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<td>Metadata DB system</td>
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<td>Design and build the IUGONET metadata DB system on the basis of DSpace</td>
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<td>Stable operation</td>
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<td>Update computers</td>
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<td>Conduct regular operation of the metadata DB and customize it as needed</td>
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<td>Design of metadata format</td>
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<td>Update the format as needed</td>
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<td>Formulate the IUGONET common metadata format and keep updating it if necessary</td>
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<td>Creation of metadata</td>
<td></td>
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<td>Open metadata thru metadata DB</td>
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<td>Target relatively old, undatabased items</td>
<td></td>
<td>Create metadata in the designated format and register them in the metadata DB system</td>
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<td>Survey &amp; Specification of</td>
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<td>analysis software</td>
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<td>Programming</td>
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<td>Rearrangement of observational DBs</td>
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<td>Rearrange DBs corresponding to metadata &amp; software</td>
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<td>Arrange relatively old, undatabased items and digitize analogue data</td>
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<td>Rearrange existing observational DBs and newly set up DBs of undatabased items</td>
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<tr>
<td>Application to scientific</td>
<td>Build project homepage</td>
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<td>Conduct interdisciplinary researches by utilizing the IUGONET products</td>
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<td>Make a self-assessment of the IUGONET products and introduce how to use them in researches</td>
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<td>researches</td>
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<td>Outreach activities</td>
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<td>Conduct promotion activities to settle the IUGONET products as an essential e-infrastructure</td>
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</table>

**Today**
Development of metadata DB

http://search.iugonet.org/iugonet

- Metadata DB platform
  DSpace - an open source software to manage digital contents and their metadata - with customization depending on our metadata

- Metadata format
  SPASE metadata model with some modifications according to characteristics of the ground-based observational data of the upper atmosphere

# of metadata registered
(as of April 2012)

1.68 million
(* including metadata of data files)
Development of Data Analysis Software

- To help users easily download, visualize, and analyze various data provided from the IUGONET institutes
- With TDAS libraries in IDL

**THEMIS Data Analysis Software suite**

Able to make stacked plots of time series to compare various kind of data

Easy to handle data by using GUI even for those who are not familiar with IDL
Outreach Activities

We are doing promotional activities to settle the IUGONET products as an essential e-infrastructure in the research communities.

● **Data analysis workshop**

We provide intensive course to learn how to use the IUGONET metadata DB & data analysis software and to analyze observational data provided by the IUGONET institutes.

**Next workshops**
- July or August 2012 @ Tachikawa
- February or March 2013 @ Nagoya

● **Online tutorial movies**

Researchers can learn how to use IUGONET metadata DB & data analysis software anytime online at the IUGONET’s YouTube site.
Provide various information of metadata database, analysis software, data provided by each institute, meeting presentations, IUGONET workshop, etc.

Provide overview of the IUGONET project and its products
The IUGONET project ([http://www.iugonet.org](http://www.iugonet.org)) builds metadata database and analysis software to promote effective distribution and use of upper atmospheric data taken by various ground-based observations.

The IUGONET products have just been released!


The IUGONET tries various promotional activities to settle the IUGONET products as an essential e-infrastructure in the research communities and plans to extend the products internationally and interdisciplinarily.