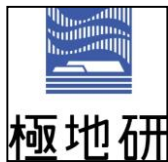




Update of metadata and tools by the IUGONET project

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Chihiro Tao⁹, and IUGONET project team



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⁴ International Research Center for Space and Planetary Environmental Science (i-SPES), Kyushu University,

⁵ Institute for Space-Earth Environmental Research, Nagoya University,

⁶ Data Analysis Center for Geomagnetism and Space Magnetism, Graduate School of Science, Kyoto University,

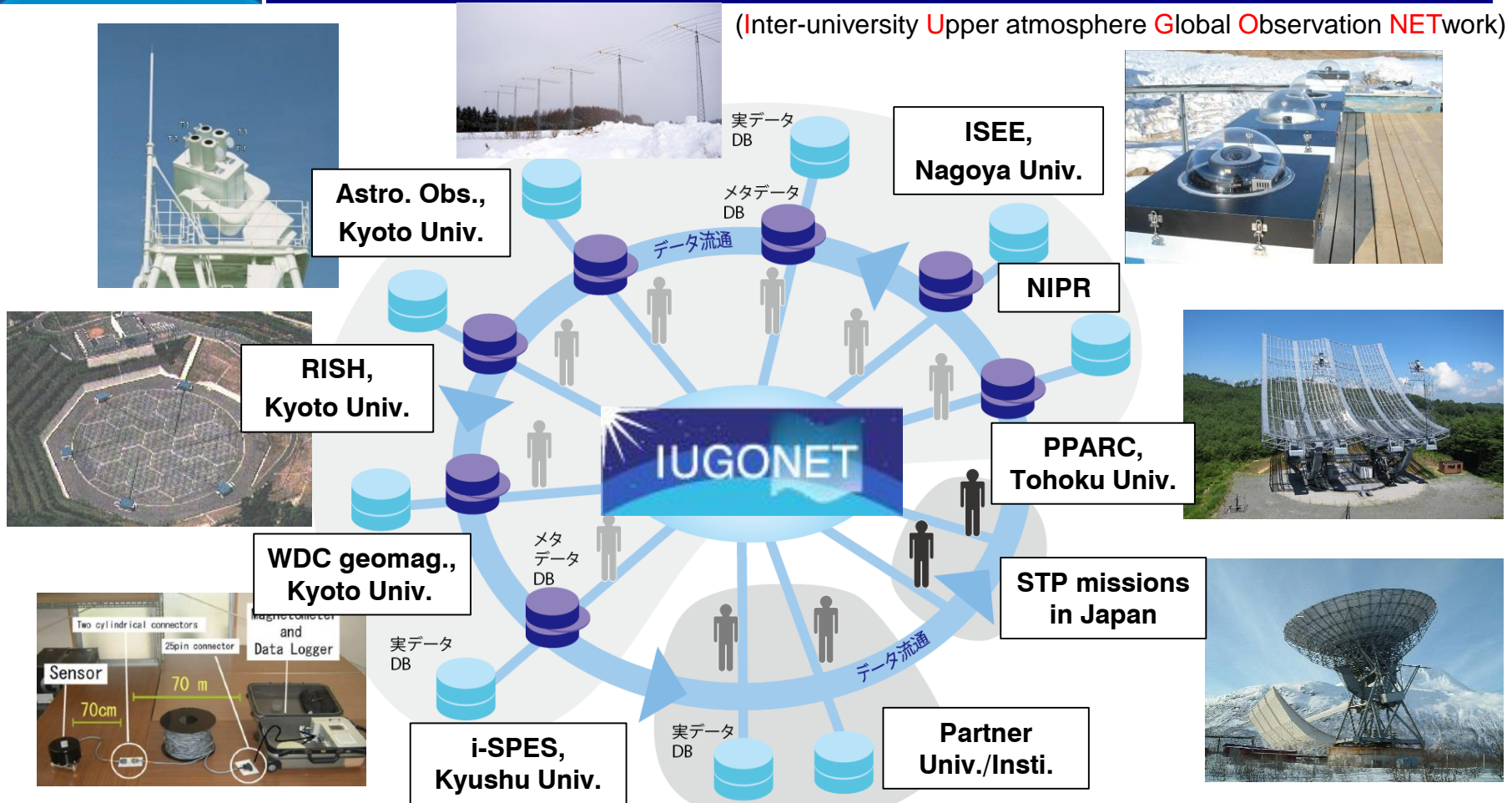
⁷ Astronomical Observatory, Graduate School of Science, Kyoto University.

⁸ Nagoya City University.

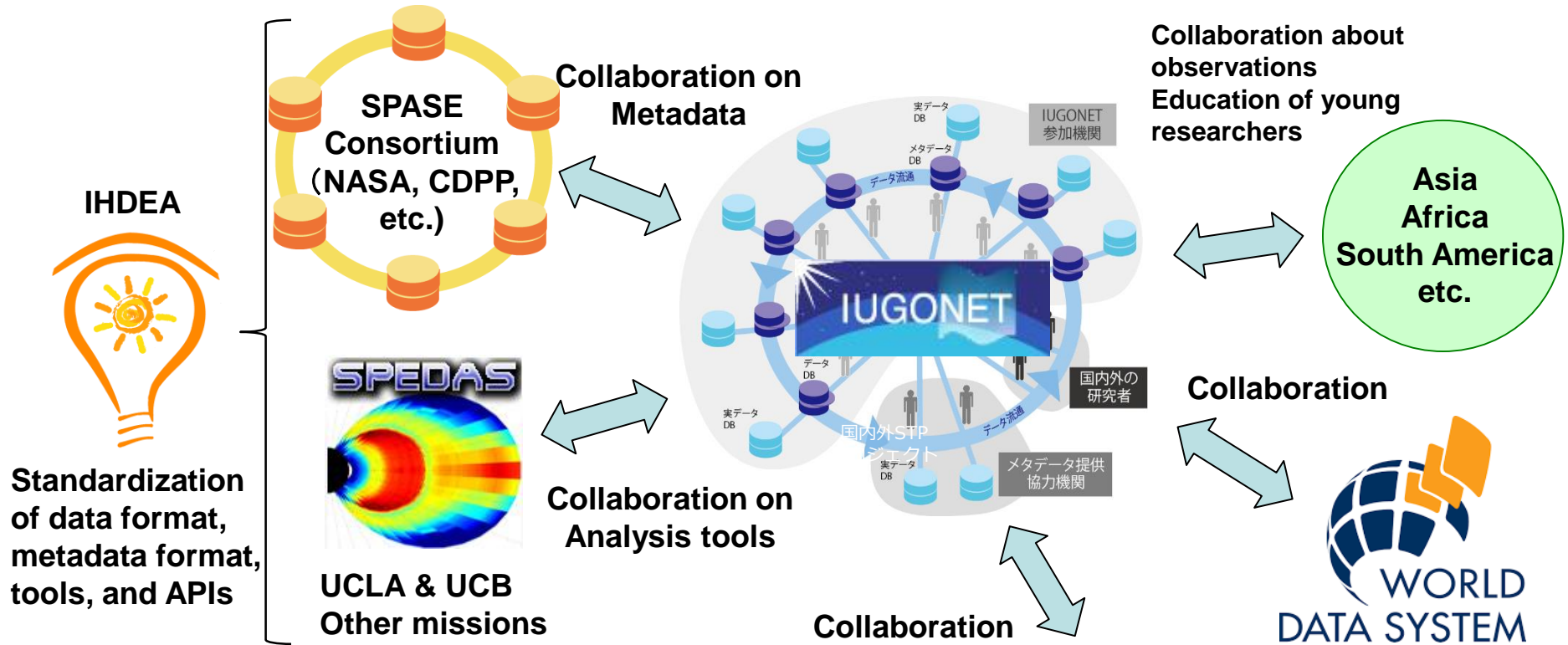
⁹ National Institute of Information and Communications Technology



(Inter-university Upper atmosphere Global Observation NETwork)



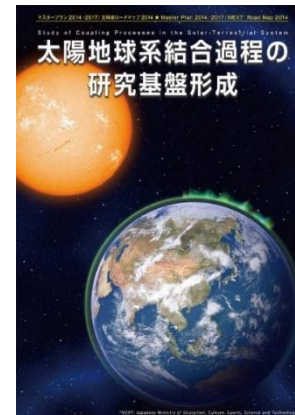
- The goals of the IUGONET project are to share the upper atmospheric data that have been separately archived by Japanese universities and institutes, and to accelerate STP research.
- We have developed some advanced tools (metadata database and analysis tools), which enable data sharing and comprehensive data analysis.



Standardization of data format, metadata format, tools, and APIs

Data files, metadata, and tools created by IUGONET are based on the recommendations by IHDEA.

未来の学術振興構想 2023/
Master Plan 2014, 2017, 2020/
Road map 2014
“Study of Coupling Processes in the Solar-Terrestrial System”



Metadata Database

1. Search
(find data and event)

2. Know
(get metadata & QL plot)

3. Examine
(plot interactively with UDAS web)

4. Advance
(know how to analyze data)

IUGONET Type-A

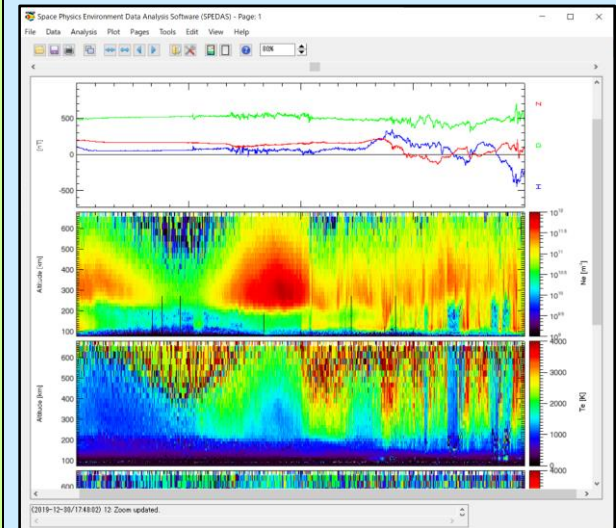
Instrument/Project	Observed Region	ERG Campaign
Satellite:		
<input type="checkbox"/> AKEBONO	<input type="checkbox"/> CHAMP	<input type="checkbox"/> COSMIC
Ground-Based:		
<input type="checkbox"/> SMART (Telescope)	<input type="checkbox"/> DST (Telescope)	<input type="checkbox"/> FMT (Telescope)
<input type="checkbox"/> Geomagnetic Indices	<input type="checkbox"/> WDC Geomag., Kyoto	<input type="checkbox"/> Geomag., Kakioka
<input type="checkbox"/> Induction	<input type="checkbox"/> Magnetometer	<input type="checkbox"/> SuperDARN
<input type="checkbox"/> PWING/PsA	<input type="checkbox"/> OMTI	<input type="checkbox"/> Lidar
<input type="checkbox"/> VLF/ELF	<input type="checkbox"/> MU Radar	<input type="checkbox"/> EA Radar
<input type="checkbox"/> VHF Radar	<input type="checkbox"/> GPS Receiver	<input type="checkbox"/> AWS
<input type="checkbox"/> X-Band Radar	<input type="checkbox"/> Others	

Analysis Tool

5. Analyze
(analyze data with SPEDAS)

6. Create
(create figures for papers)

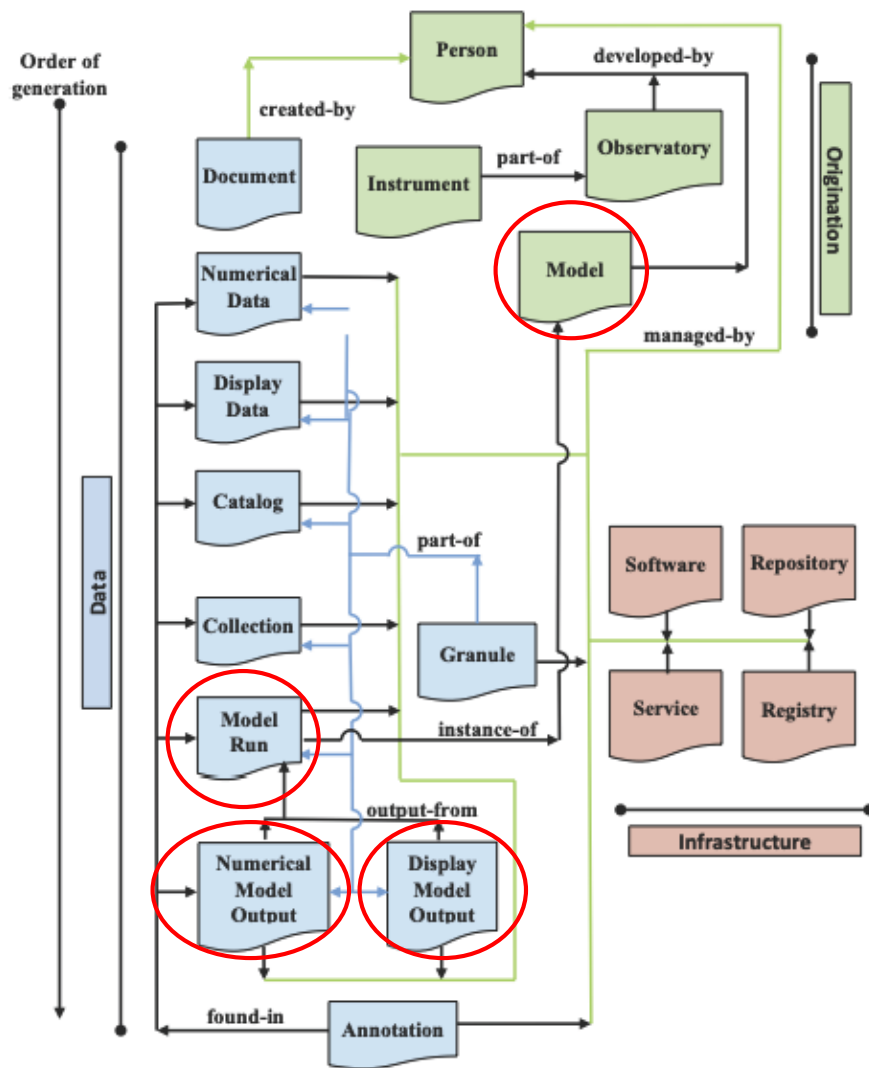
SPEDAS



- IUGONET metadata database (**IUGONET Type-A**) provides one-stop web service for researchers to search data, get the information of data, and interactively visualize data.
- **More than 1200 metadata** for upper atmosphere data except for the "Granule" have been registered to IUGONET Type-A.

- The current IUGONET metadata (2.4.0.1) is based on the **SPASE 2.4.0** data model.
- These metadata have been converted to **SPASE 2.6.1**, and will be opened to public soon.
- The SPASE 2.6.1 schema can be used for **simulation data**.

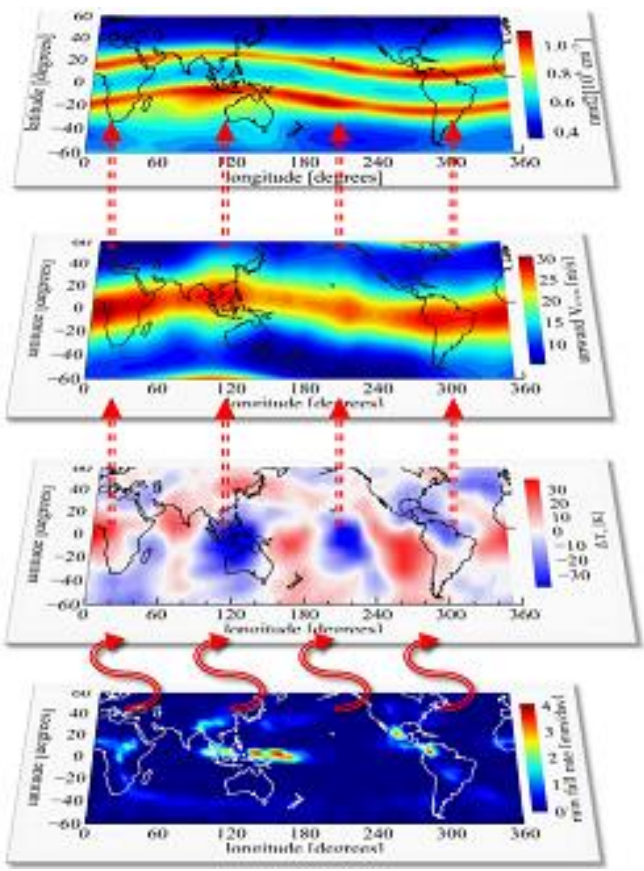
SPASE Information Model



A metadata for GAIA simulation data was created by **National Institute of Information and Communications Technology (NICT)** and will be registered to our database.

```

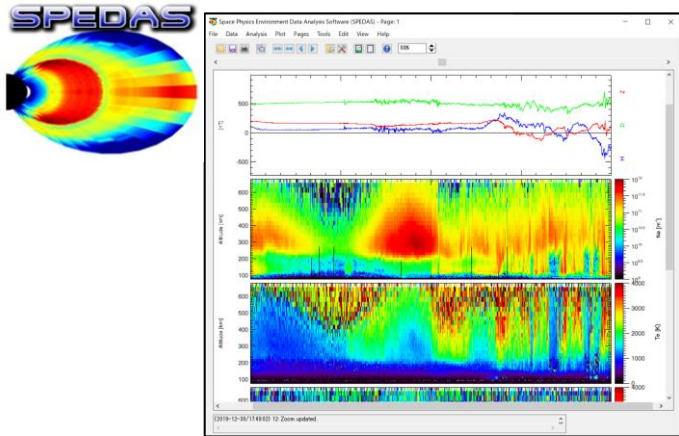
<?xml version="1.0" encoding="UTF-8" ?>
<Spase xmlns="http://www.spase-group.org/data/schema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="https://spase-group.org/data/schema/spase-2.6.1.xsd">
  <Version>2.6.1</Version>
  <NumericalOutput>
    <ResourceID>spase://IUGONET/NumericalOutput/NICT/misc/GAIA_longterm_ver1</ResourceID>
    <ResourceHeader>
      <ResourceName>GAIA long-term simulation version 1</ResourceName>
      <ReleaseDate>2024-08-08T00:00:00</ReleaseDate>
      <Description>The Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy (GAIA) is an Earth's
atmosphere-ionosphere coupled model that seamlessly treats the neutral atmospheric region from the
troposphere to the thermosphere as well as the thermosphere-ionosphere interactions, including
electrodynamics self-consistently. The long-term simulation outputs and related data from GAIA are
provided for noncommercial usage in research on the mesosphere, thermosphere, and ionosphere regions.
</Description>
      <Acknowledgement>Please cite the dataset with doi when and where appropriate.</Acknowledgement>
    </ResourceHeader>
    <Contact>
      <PersonID>spase://IUGONET/person/GAIA_pj</PersonID>
      <Role>GeneralContact</Role>
    </Contact>
  </NumericalOutput>
  <AccessInformation>
    <RepositoryID>spase://IUGONET/Repository/NICT/GAIA_web</RepositoryID>
    <Availability>Online</Availability>
    <AccessURL>
      <Name>GAIA Data Archive</Name>
      <URL>https://gaia-web.nict.go.jp/data_e.html</URL>
      <Description>Output data from GAIA simulation can be downloaded from this link.</Description>
    </AccessURL>
    <Format>NetCDF</Format>
    <Acknowledgement>Jin, H., Y. Miyoshi, C. Tao, H. Fujiwara, and H. Shinagawa (2024), GAIA long-term
simulation version 1</Acknowledgement>
  </AccessInformation>
</Spase>
  
```



After discussion with the SPASE team, some modifications was made to the SPASE schema, e.g., new words such as GCM, AOGCM (Coupled atmosphere-ocean-sea ice global climate models), and NonHydrostatic were added to “Model Type”.

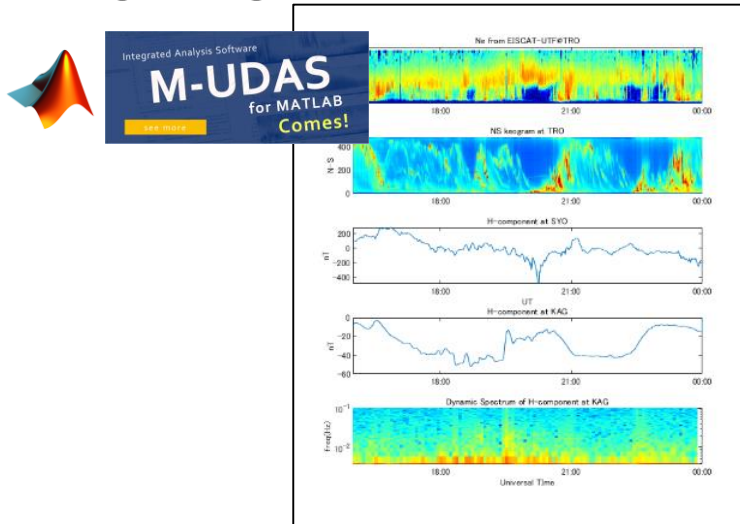
GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy) simulation data

SPEEDAS/UDAS



- Space Physics Environment Data Analysis Software (SPEEDAS) is a grass-roots data analysis software for the Space Physics community.
- Written in Interactive Data Language (IDL).
- About 40 kinds of load procedures for IUGONET data are included in SPEEDAS.
- The latest version of the plug-in is available at the IUGONET website (<http://www.iugonet.org/>).

M-UDAS



- Written in MATLAB, which is widely used by researchers in European and African countries.
- Approximately 20 different data loading functions are available on GitHub (<https://github.com/iugonet/UdasMatlab>)



Development of IUGONET Plugin for PySPEDAS



Python-based iUgonet Data Analysis Software (PyUDAS) +



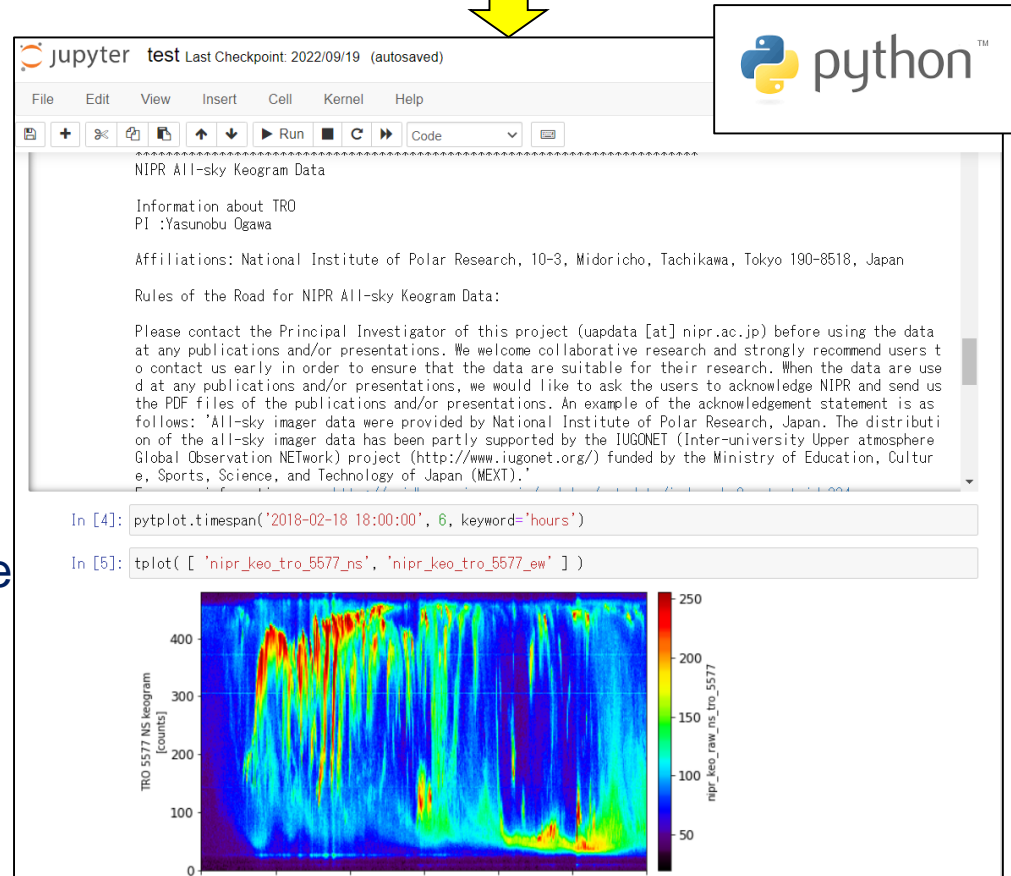
Python-based Space Physics Environment Data Analysis Software (PySPEDAS)

<https://github.com/iugonet/pyudas>

<https://github.com/spedas/pyspedas>



- We started to develop a plug-in software (called **PyUDAS**) for PySPEDAS in 2022, and the development is still ongoing.
- As of September 2024, **more than 20 load routines for the upper atmosphere data** (from magnetometers, all-sky imagers, radars, riometers, etc.) are available on GitHub.
- We hope to incorporate the plugin into **PySPEDAS** in future.



- Around 2013, **several WDS institutions in Japan** and **NICT** created a mapping table between the IUGONET metadata schema (based on SPASE 2.2.2) and **JaLC (Japan Link Center)** metadata schema, and developed a system that can register data DOIs using the IUGONET metadata.
- Recently, NICT updated the mapping table and replaced the system with new one that can register data DOIs using **SPASE 2.6.0 metadata**. IUGONET also entered to a search member of JaLC.

DOI:10.17591/55838dbd6c0ad

Mesospheric wind velocity data (30min. mean) observed with MF radar at Poker Flat, Alaska

Horizontal wind velocity in the altitude range of approx. 60-90 km is observed with Poker Flat MF (medium frequency) radar, using the radar wave at 2.43 MHz. The radar receives weak radio echo signals returned from the weakly ionized atmosphere (ionospheric D-region) at the target altitudes, to deduce horizontal air motions (Murayama, Y., K. Igarashi, D. D. Rice, B. J. Watkins, R. L. Collins, K. Mizutani, Y. Saito, and S. Kainuma, Medium Frequency Radars in Japan and Alaska for Upper Atmosphere Observations, IEICE Trans., E83-B, pp.1996-2003, 2000). Poker Flat MF radar has been constructed as part of Japan-US joint research program of Arctic middle & upper atmosphere ("Alaska Project") in collaboration between National Institute of Information and Communications Technology, Japan (formerly Communications Research Laboratory), and Geophysical Institute, University of Alaska Fairbanks.

Data Citation
Citation: Alaska Project of NICT (CRL-GI/UAF, Mesospheric wind velocity data (30min. mean) observed with MF radar at Poker Flat, Alaska, doi:10.17591/55838dbd6c0ad

General Characteristics
Parameters: Mesospheric horizontal wind velocity
Processing level:
Temporal resolution: 30 minutes
Start date: 1998-10-16T01:45:00
Stop date: -PT1D

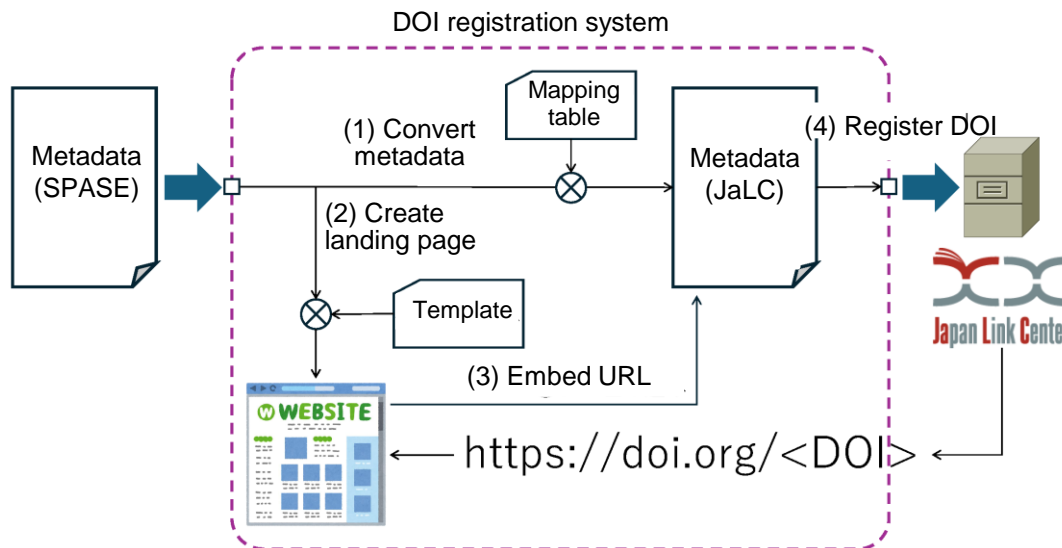
Observatory Location
Observatory: Poker Flat, Alaska
Latitude: 65.1°
Longitude: -147.5°
(Note: Latitudes and longitudes are expressed in decimal degrees. Eastern longitudes and Northern latitudes are positive.)

Citation & Contact Information
Acknowledgements: Alaska Project of NICT (CRL-GI/UAF, Mesospheric wind velocity data (30min. mean) observed with MF radar at Poker Flat, Alaska
Contact Persons: Yasuhiro Murayama(oid:0000-0003-1129-334X)

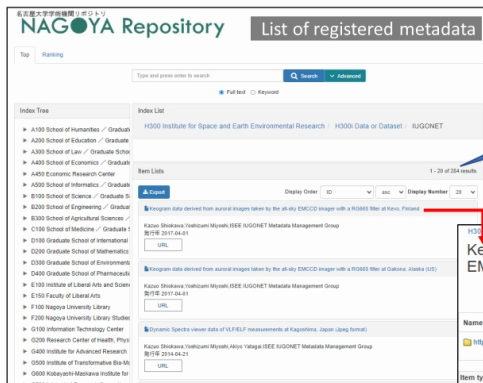
Links
Data Access: <http://salmon.nict.go.jp/>
DOI: [10.17591/55838dbd6c0ad](https://doi.org/10.17591/55838dbd6c0ad)
Digital Object Identifier
How to Cite Datasets: <http://www.dcc.ac.uk/resources/how-guides/cite-datasets>
Ball, A. and M. Duke [2011], How to cite datasets and link to publications, DCC How-to Guides, Edinburgh: Digital Curation Centre.

Provider Version
1.0

Update History
2019-01-28T17:18:17+0900
2016-03-16T13:24:28+0900
2015-06-19T13:10:39+0900
2015-06-19T12:55:24+0900



- Converted metadata from **SPASE** to **JPCOAR** (metadata schema for institutional repository) in collaboration with ISEE, Nagoya Univ., i-SPEs, Kyushu Univ., Nagoya University Library, and Kyushu University Library.
- 284** ground-based observation data from ISEE, Nagoya University and **180** ground-based observation data from i-SPEs, Kyushu University were registered in the institutional repositories of each university.
- Metadata registered in institutional repositories were automatically harvested into the **Institutional Repositories DataBase (IRDB)** of National Institute of Informatics (NII), and can be searched using **Google Dataset Search.**



284 results

https://nagoya.repo.nii.ac.jp/search?search_type=2&q=1668993801802

Keogram data derived from auroral images taken by the all-sky EMCCD imager with a RG665 filter at Kevo, Finland

<http://hdl.handle.net/2237/000204390>

Name / File	License	Actions
https://nagoya.repo.nii.ac.jp/records/2004390		Information

273 views

Item Type: Itemtype_data_ver(1)

PubDate: 2023-01-31

Title: Keogram data derived from auroral images taken by the all-sky EMCCD imager with a RG665 filter at Kevo, Finland

Language: en

Creator: Kazuo Shokawa, ISEE IUGONET Metadata Management Group

Contributor: Kazuo Shokawa, ISEE IUGONET Metadata Management Group

Contributor Type: ProjectMember

Contributor Name: Kazuo Shokawa

Affiliation Name: Institute for Space and Earth Environmental Research, Nagoya University

Export: OAI-PMH, JPCOAR, DublinCore, DOI

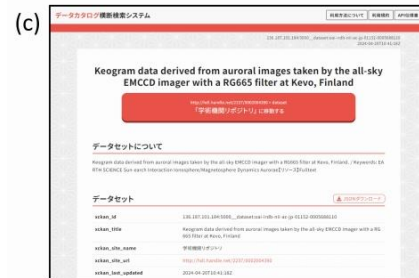
A example of metadata registered in Nagoya Repository



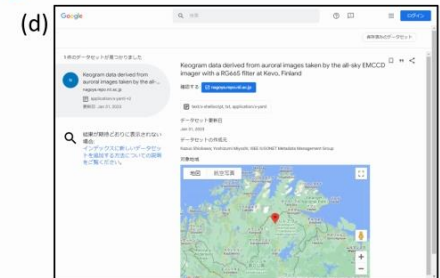
<https://nagoya.repo.nii.ac.jp/records/2004390>



<https://irdb.nii.ac.jp/01152/0005688110>



https://search.ckan.jp/datasets/136.187.101.184:5000__dataset:oi-irdb-nii-ac-jp-01152-0005688110



<https://datasetsearch.research.google.com/search?docid=L2cvMTFR0V09NjZkg>

Metadata is registered in various databases by Harvest.



Details of this topic will be presented by Nose-san this evening.

<https://amider.rois.ac.jp/>

The screenshot shows the AMIDER website interface. At the top, there is a search bar with '検索ワードを入力してください' and buttons for 'AND', 'OR', and '検索'. Below the search bar, there are navigation tabs for '現在までのコンテンツ' and '検索結果'. The '検索結果' section displays a grid of 15 search results, each with a thumbnail image and a brief description. The results include various scientific data and samples, such as 'ノルウェー・スバル(ルノロン)の金星カラーデジタルカメラで撮影されたオーロラ画像' and '1987-1988年シーズンに南極アサカ基地付近で発見された隕石 (A-87136) のパルク化学組成データ'.

- Collaboration with **AMIDER** project in **Polar Environment Data Science Center (PEDSC)**, **DS-ROIS**.
- Registered IUGONET metadata on the AMIDER database that integrates data from various research fields and aims to promote interdisciplinary study.
- Currently, the AMIDER database contains **biological**, **geoscience**, **meteorological**, **glaciological**, and upper atmospheric data.
- Provides a service for downloading CDF, netCDF, and ASCII files, displaying visualized data, and showing related data.

- IUGONET has supported the metadata creation and data publication and developed the visualization and analysis tools. The data formats (**CDF, NetCDF, FITS**), metadata (**SPASE**), and tools (**SPEDAS, PySPEDAS**) used by IUGONET are based on the recommendations by **IHDEA**.
- The current IUGONET metadata was created based on SPASE 2.4.0. We converted the metadata to the **SPASE 2.6.1** format and will open them to public soon.
- We successfully created the metadata for GAIA simulation data in SPASE 2.6.1.
- We have developed the IUGONET plug-in tool (**PyUDAS**) for **PySPEDAS**. **More than 20 load routines** are available on GitHub.
- NICT developed a new system that can register data DOIs using **SPASE 2.6.0 metadata**, so we can use it to register DOIs for the upper atmosphere data.
- We registered the IUGONET metadata in the **AMIDER** database and **institutional repositories** to promote inter-disciplinary study and improve searchability.