



# Inter-university Upper atmosphere Global Observation NETWORK (IUGONET) Metadata Database

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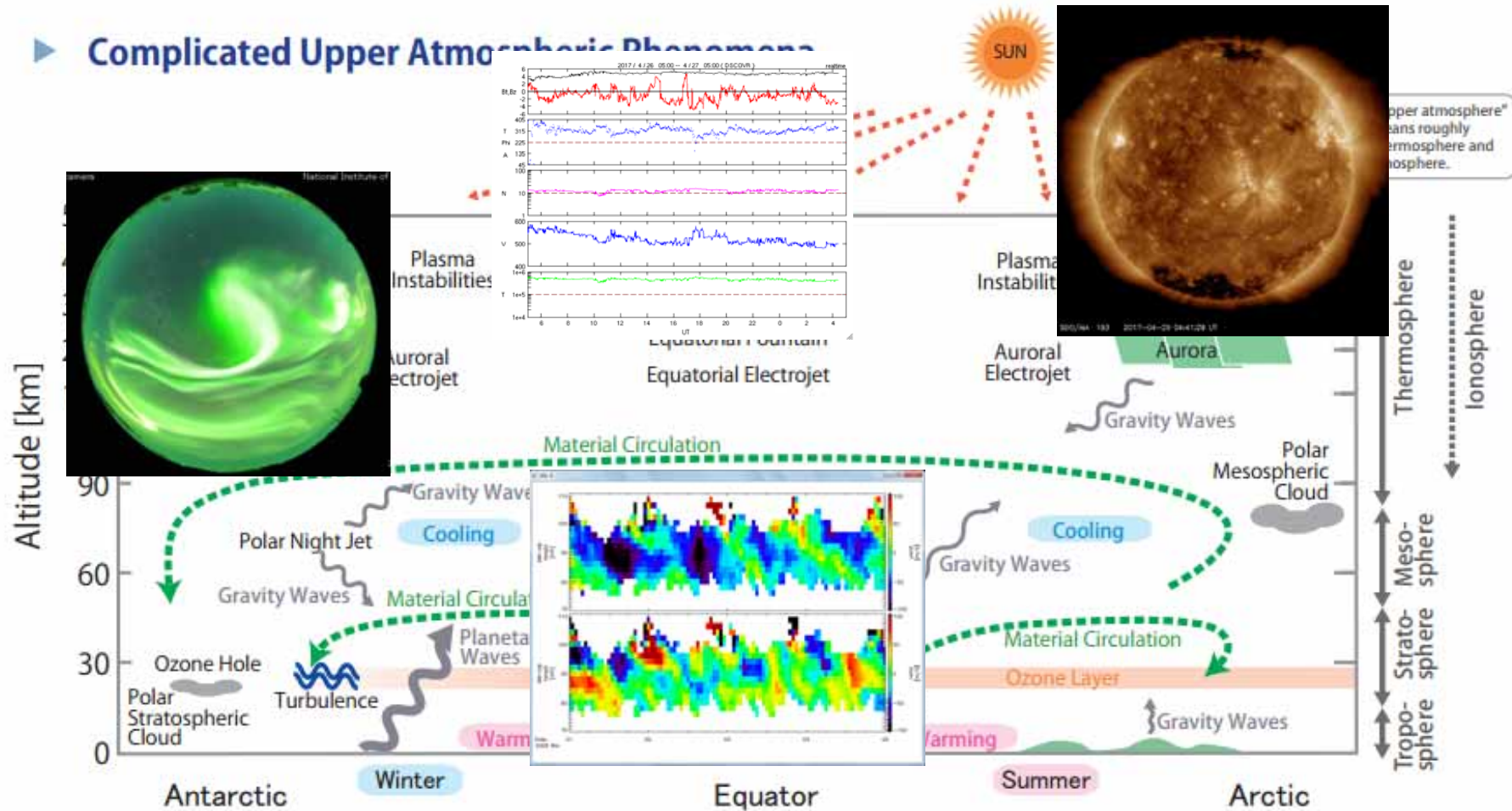
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<sup>7</sup> World Data Center for Geomagnetism, Kyoto University.



# Upper atmosphere is too vast and complicated!

## ► Complicated Upper Atmospheric Phenomena



- Consists of multiple layers between the Sun and the Earth's surface.
- Meridional coupling and horizontal circulation play an important role in the formation of the Earth's atmosphere.
- Phenomena in the upper atmosphere are affected by the energy inputs from both space and lower atmosphere.

## Current issues:

- There are a variety of data set (and a variety of file formats for each data).
  - Database has been maintained individually by each university / institute.
- It is time consuming to find, collect, know and analyze the data.



## Solutions:

- Development of **Metadata Database** to cross-search data distributed across many universities and institutes.

→ **IUGONET Type-A**

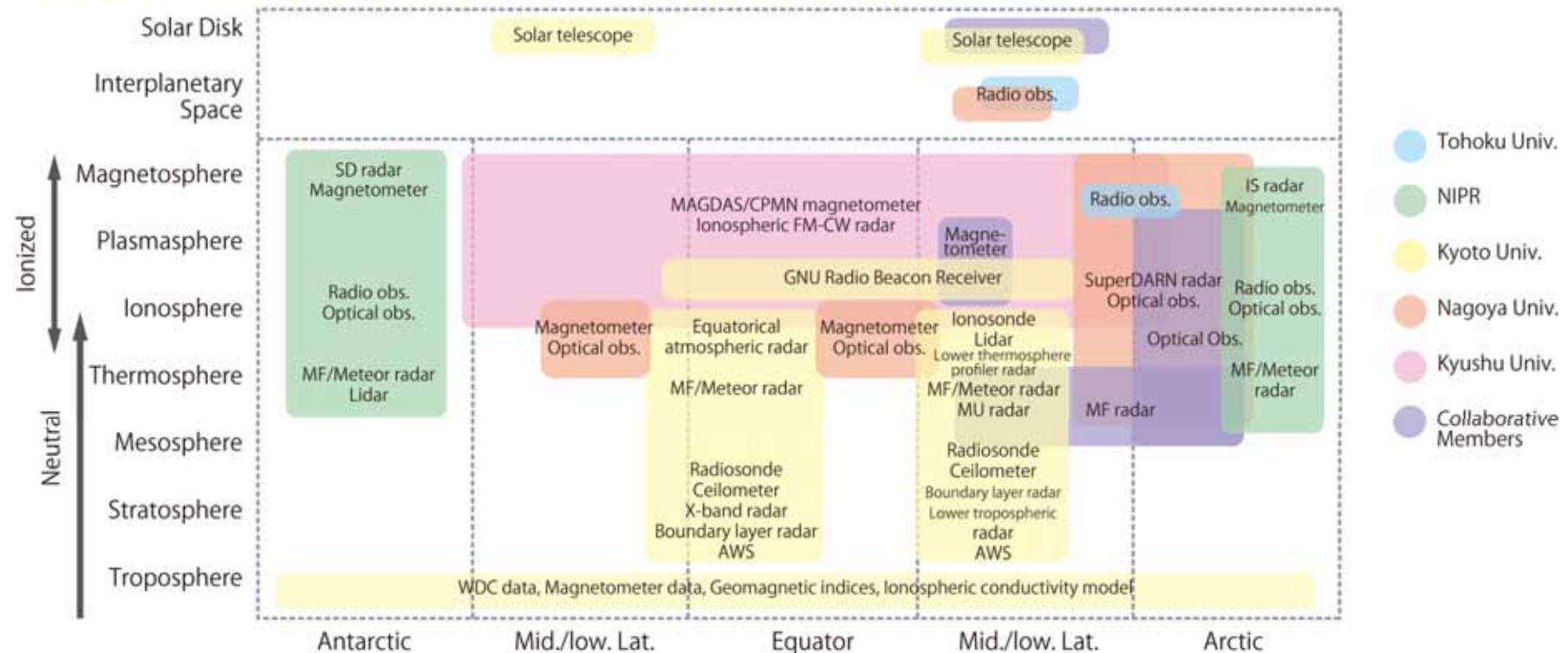


- Development of **Analysis Software** that can handle various types of data in an integrated fashion.

→ **SPEEDAS/UDAS**



## ► IUGONET Global Network of Ground-Based Observations



- IUGONET handles data obtained by various kinds of instruments.
- So, it is often difficult to understand what data are important and how the data should be analyzed for users' purpose.

It is important for users to share not only data, but also **the information of data!**



# Data Analysis Software : SPEDAS

- SPEDAS (Space Physics Environment Data Analysis Software) is a grassroots software that can handle data from **multiple satellite and ground-based missions**.
- Data supported by SPEDAS are basically open and **can be easily downloaded via internet** with a few commands.
- It is suitable for interdisciplinary study such as space weather.

## Data supported by SPEDAS

### Satellite data

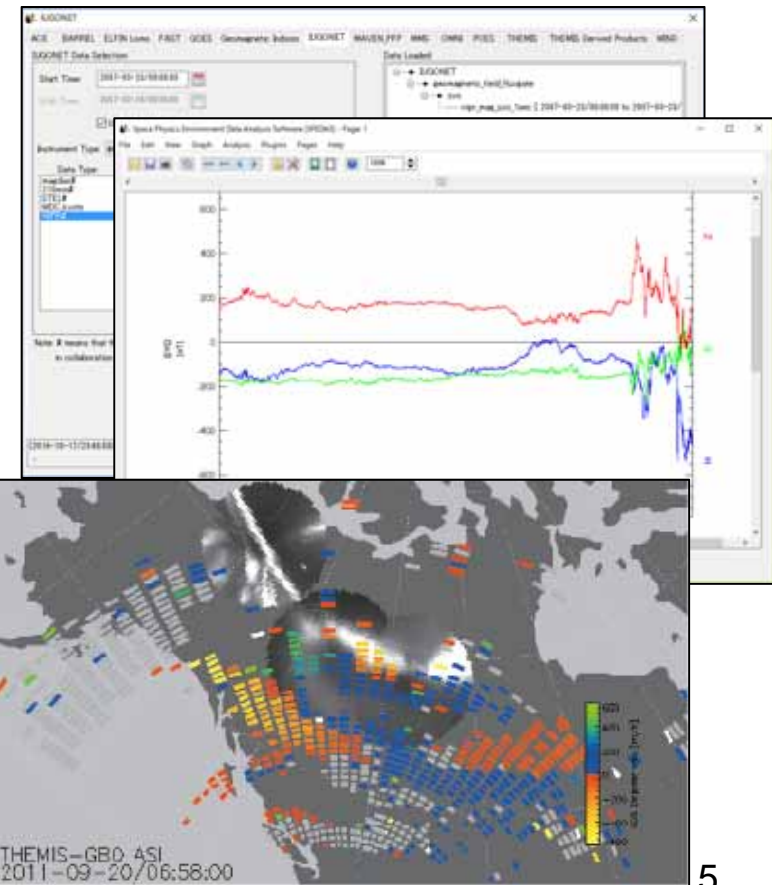
Stereo	SOHO	Wind	ACE	IMP-8	RBSP
<b>THEMIS</b>	GOES	LANL	NASA OMNI	ERG	MMS
POES	MAVEN				

### Ground-based observational data

THEMIS Mag.	THEMIS ASI
CARISMA Mag.	GIMA Mag.
Greenland Mag.	MACCS Mag.
<b>ERG ground</b> 210MM, SuperDARN, Magnetometer	

**IUGONET**

Solar Telescope, Solar and planetary radio telescope, Ionosphere radar (SuperDARN, EISCAT, etc.), Atmosphere radar (MU, EAR, etc.), Meteorological observation data, Geomag. network (WDC, MAGDAS, 210MM, Antarctica · Iceland, etc.)

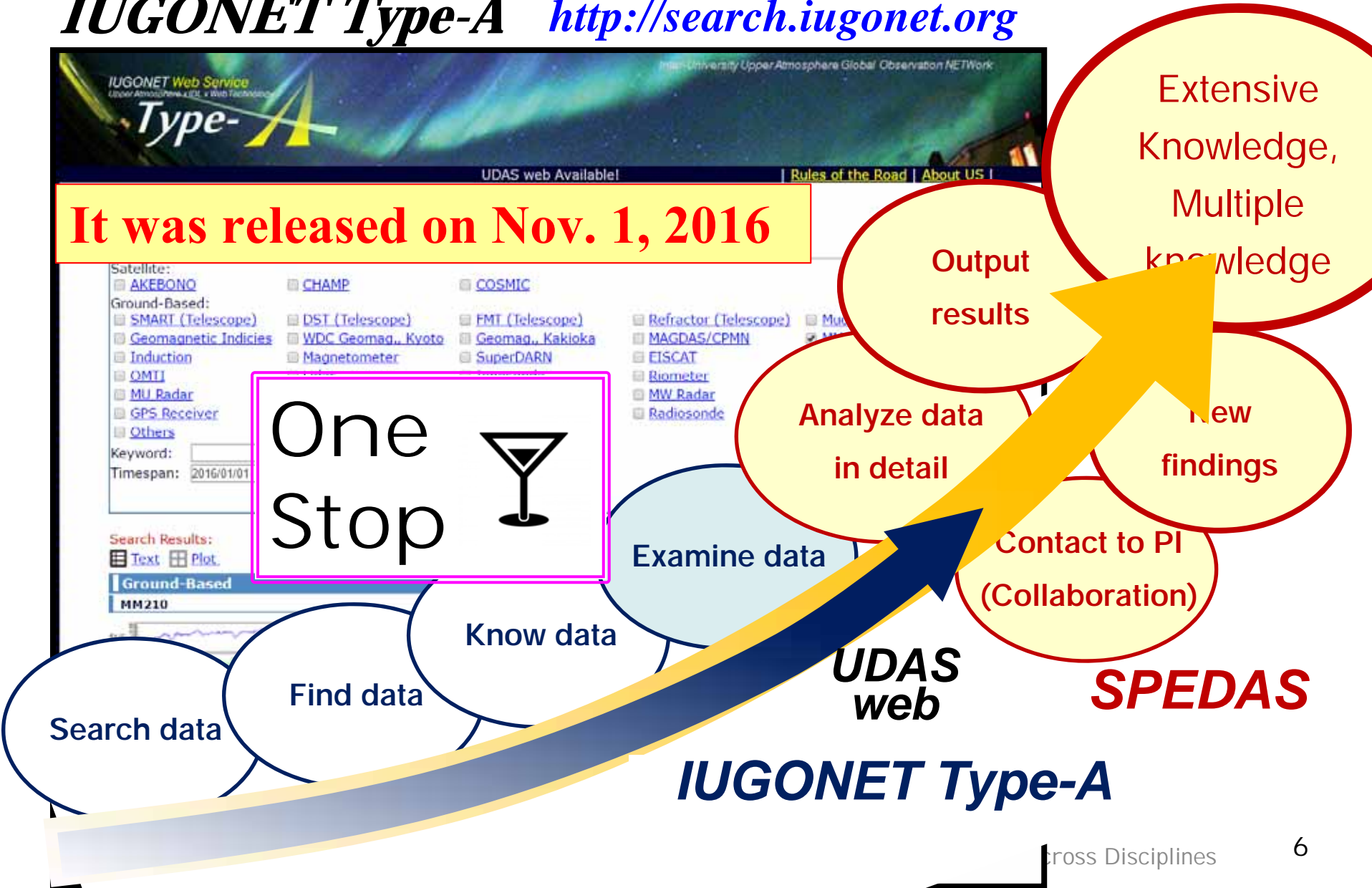


***IUGONET Type-A*** <http://search.iugonet.org>

The screenshot shows the IUGONET Type-A search interface. At the top, it says "IUGONET Web Service" and "Type-A". Below that, there are navigation links like "UDAS web Available!" and "Rules of the Road | About US |". The main part of the interface is a search filter section with categories like "Satellite:", "Ground-Based:", and "Keyword:". Under "Satellite:", there are checkboxes for AKEBONO, CHAMP, and COSMIC. Under "Ground-Based:", there are checkboxes for SMART (Telescope), DST (Telescope), FMT (Telescope), Refractor (Telescope), Geomagnetic Indices, WDC Geomag., Kyoto, Geomag., Kakioka, MAGDAS/CPMN, Induction, Magnetometer, SuperDARN, EISCAT, OMI, Riometer, MU Radar, MW Radar, GPS Receiver, and Radiosonde, and Others. There is a "Keyword:" field and a "Timespan:" field set to "2016/01/01". Below the filters, there are "Search Results:" options for "Text" and "Plot". A search result for "Ground-Based MM210" is visible.

**It was released on Nov. 1, 2016**

**One Stop**



<http://search.iugonet.org>

**IUGONET Data Set**

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

[Refractor \(Telescope\)](#)  [Muon \(Telescope\)](#)  
 [MAGDAS/CPMN](#)  [MM210](#)  
 [EISCAT](#)  [Imager](#)  
 [Ionosonde](#)  [Riometer](#)  
 [MF Radar](#)  [MW Radar](#)  
 [BL/LT/WP Radar](#)  [Radiosonde](#)

Keyword:   
 Timespan:  To  [Set Detail](#)

**Information**

The first campaign of the ERG (Arase) - ground coordinated observations in March - April 2017.

1. Gakona (Alaska), PWING/PSA  
 2. Gakona (Alaska), PWING/PSA  
 3. Gakona (Alaska), PWING/PSA  
 4. Gakona (Alaska), PWING/PSA  
 5. Gakona (Alaska), PWING/PSA  
 6. Tromso (Norway), EISCAT  
 7. Gakona (Alaska), PWING/PSA  
 8. Tromso (Norway), EISCAT

The Arase (ERG) satellite was launched at 20:00 (JST) on December 20, 2016 from Uchinoura Space Center, JAXA with an ellipse

Search from the lists of some categories such as Instrument/Project and Observed Region

Search by setting keywords, data and time. eg., 2012/03/05~2012/03/11.

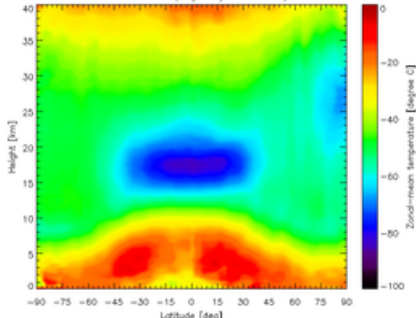
## Quick-look display of search results

[Text](#) [Plot](#) [<Prev](#) [Numerical: 2012/03/05 00:00:00 - 2012/03/12 00:00:00](#), [Plot/Movie: 2012/03/11](#), Timespan: [1](#), [3](#), [7](#) [Next>](#)

**Satellite**

**COSMIC**

2012-03-11 (Day of year = 071)

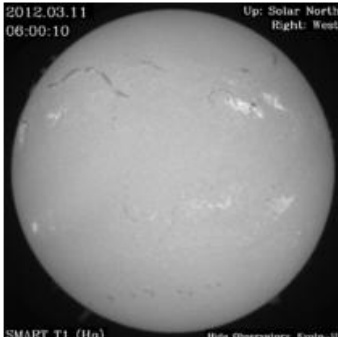
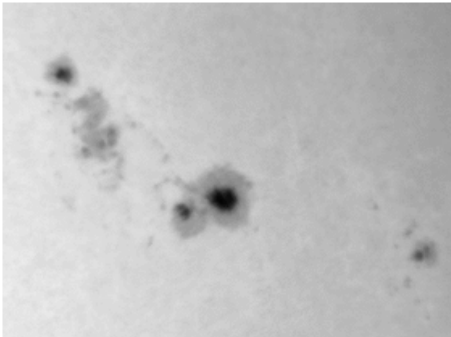


Height [km] vs Latitude [deg] vs Zonal-mean temperature [Degree C]

[Plot/Movie Data](#) [COSMIC full spectrum inversion \(FSI\) data \(PNG\)](#)

**Ground-Based**

**SMART (Telescope)**



2012.03.11 06:00:10 Up: Solar North Right: West

SMART T1 (H $\alpha$ ) Hida Observatory, Kyoto-U

[Plot/Movie Data](#) [Quick-look images of SMART/T3 H-alpha and continuum partial-region solar images](#) [Plot/Movie Data](#) [SMART/T1 H-alpha full-disk solar images in JPEG format](#)

**DST (Telescope)**

Satellite data

Solar Telescope data



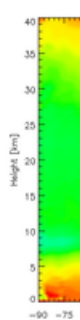
## Quick-look display of search results

<Prev
11, Timespan: 1, 3, 7

Text

Satellite

COSMIC



Plot/Movie inversion


Ground

SMART

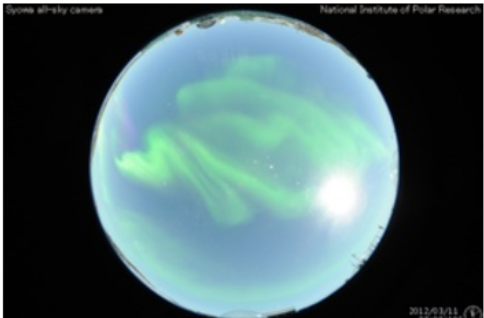
Plot/Movie SMART/T3 region sol

DST (Te

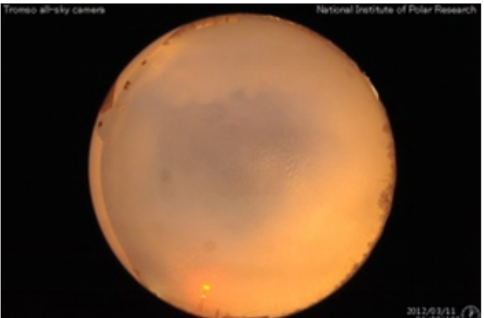
**Imager**



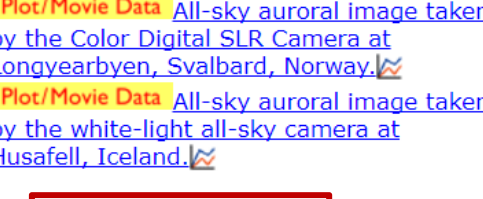
**Plot/Movie Data** [All-sky auroral image taken by the Color Digital SLR Camera at Longyearbyen, Svalbard, Norway.](#)




**Plot/Movie Data** [All-sky auroral image taken by the Color Digital SLR Camera at Syowa Station, Antarctica.](#)



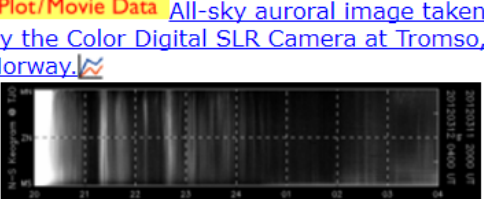
**Plot/Movie Data** [All-sky auroral image taken by the Color Digital SLR Camera at Tromsø, Norway.](#)



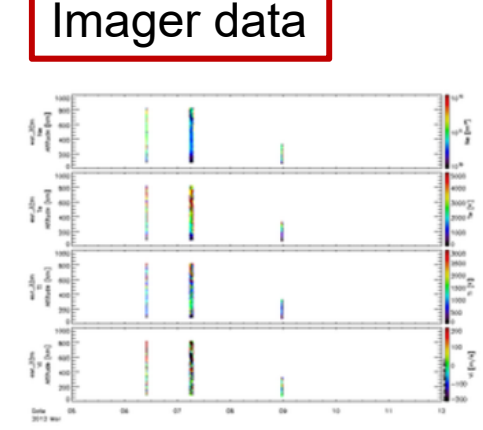
**Plot/Movie Data** [All-sky auroral image taken by the white-light all-sky camera at Husafell, Iceland.](#)



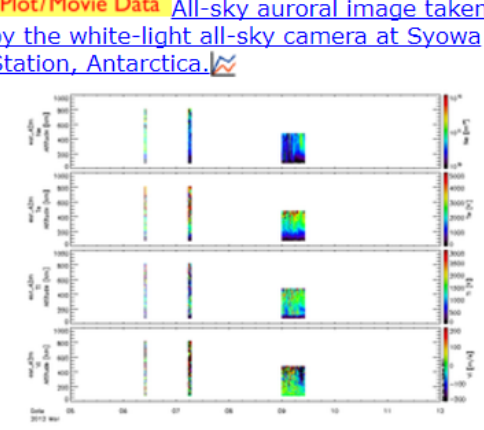
**Plot/Movie Data** [All-sky auroral image taken by the white-light all-sky camera at Syowa Station, Antarctica.](#)



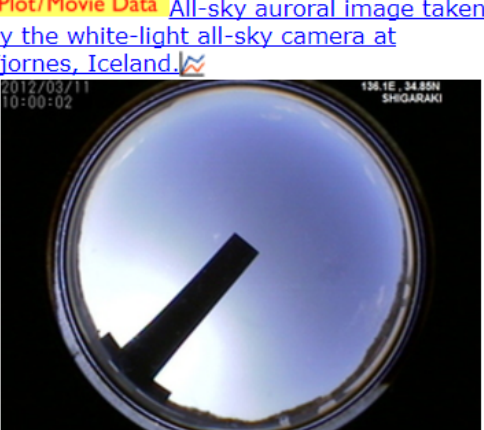
**Plot/Movie Data** [All-sky auroral image taken by the white-light all-sky camera at Tjornes, Iceland.](#)



**Numerical Data** [Basic parameters obtained by the 32m ESR](#)



**Numerical Data** [Basic parameters obtained by the 42m ESR](#)



**Plot/Movie Data** [Observation data taken by the visible all-sky camera at Shigaraki MU Observatory](#)

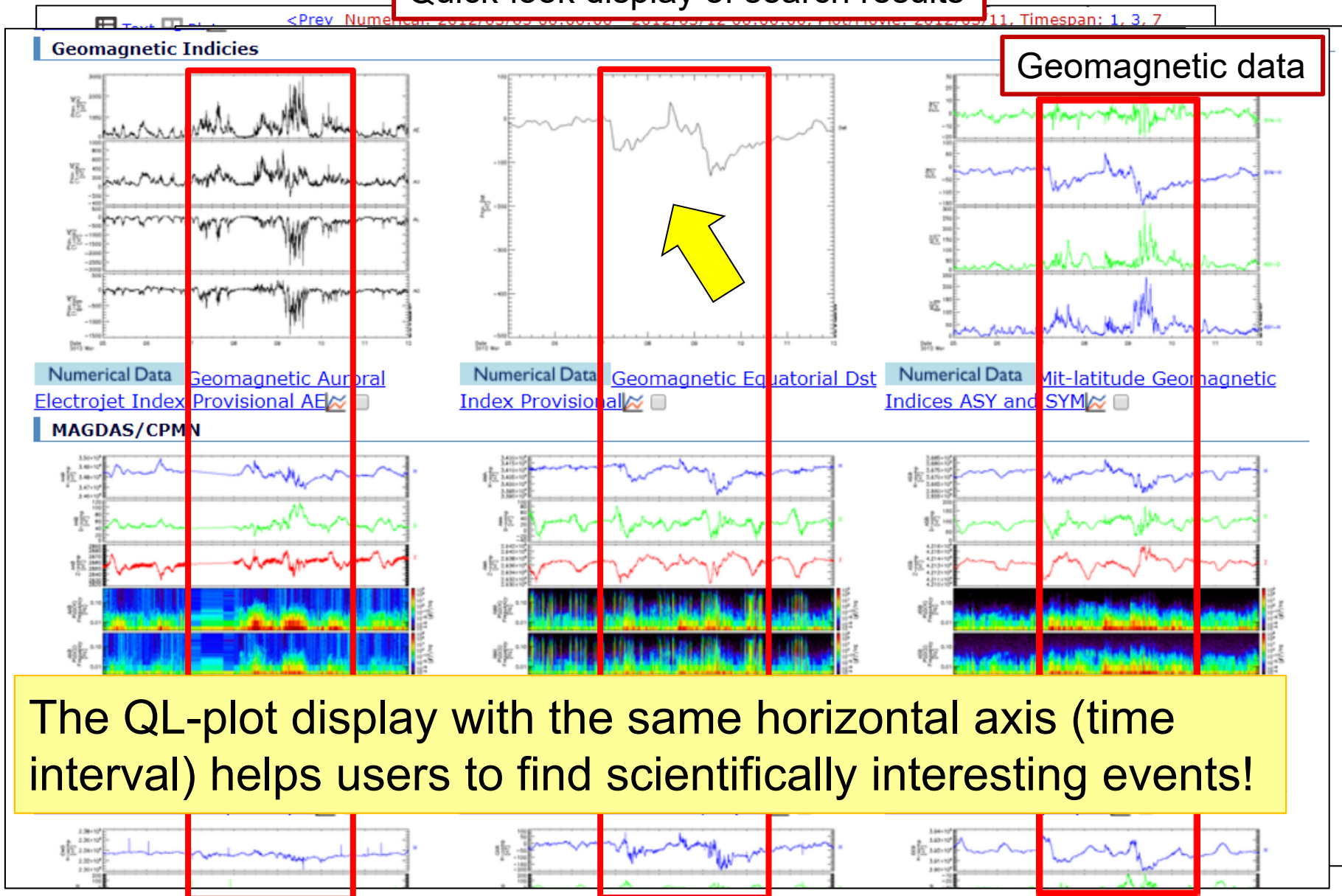
### Imager data

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# Find data and interesting events

Quick-look display of search results



Geomagnetic data

The QL-plot display with the same horizontal axis (time interval) helps users to find scientifically interesting events!

## Metadata display page

**Description:**

The geomagnetic equatorial Dst index at 1-hr time resolution, derived at World Data Center for Geomagnetism, Kyoto, Kyoto University. The provisional Dst index is calculated from geomagnetic field data which were visually screened for artificial noises.

**Acknowledgement:** If the data are used in publications and presentations, the data suppliers and the WDC for Geomagnetism, Kyoto must properly be acknowledged.

**ReleaseDate:** 2011-02-17T08:00:00

**Contact (GeneralContact):**

The IUGONET metadata format was created based on **SPASE (Space Physics Archive Search and Extract)**, which is the metadata format developed by international consortium to comprehensively describe research resources regarding heliospheric and magnetospheric satellite observations.



**Format:** Text

**Processing Level:** Calibrated

**Measurement Type:** ActivityIndex

**Time Span:**

**StartDate:** 2012-01-01T00:00:00

**StopDate:** 2015-03-31T00:00:00



Scroll down

## Metadata display page

### How to Plot (SPEDAS-CUI #Basic):

```
IDL> thm_init
THEMIS> timespan, ['2012-03-04 00:00:00', '2012-03-11 00:00:00']
THEMIS> iug_load_gmag_wdc, site='dst', level='provisional'
THEMIS> tplot, 'wdc_mag_dst_prov'
```

CUI #Basic: SPEDAS commands minimally required to plot the data

### How to Plot (SPEDAS-CUI #Advanced [\*Quick-Look was created with this command]):

```
IDL> thm_init
THEMIS> timespan, ['2012-03-04 00:00:00', '2012-03-11 00:00:00']
THEMIS> iug_load_gmag_wdc, site='dst', level='provisional'
THEMIS> ylim, 'wdc_mag_dst_prov', -500, 100
THEMIS> tplot, 'wdc_mag_dst_prov'
```

CUI #Advanced: SPEDAS commands used to create QL plot in the metadata display page.

### How to Plot (SPEDAS-GUI):

```
Step 1: Start SPEDAS GUI Program.
Step 2: Choose [FILE] -> [Load Data].
Step 3: Choose [IUGONET] Tab.
Step 4: Uncheck 'Use Single Day'.
Step 5: Set Start Time: '2012-03-04 00:00:00' and Stop Time: '2012-03-11 00:00:00'.
Step 6: Choose Instrument Type: 'geomagnetic_field_index'.
```

GUI: How to plot the data with SPEDAS-GUI.

“How to plot” section shows how to plot the data by the dedicated software “SPEDAS”.

→ Guide users to advanced analysis

UDAS web page

**UDAS web**

**Step.1: Set Time Range**

From: 2012 ▾ 03 ▾ 04 ▾ 00 ▾ 00 ▾ 00 ▾  
To: 2012 ▾ 03 ▾ 11 ▾ 00 ▾ 00 ▾ 00 ▾

**Step.2: Choose Variables to Plot**

Numerical Data [MM210\\_Kagoshima\\_magnetometer\\_1\\_min\\_resolution\\_data\\_distributed\\_by\\_ERG-SC](#)

- mm210\_mag\_kag\_1min\_hdz\_x (North-South magnetic field at Kagoshima)
- mm210\_mag\_kag\_1min\_hdz\_y (East-West magnetic field at Kagoshima)
- mm210\_mag\_kag\_1min\_hdz\_z (Vertical magnetic field at Kagoshima)
- mm210\_mag\_kag\_1min\_hdz\_x\_dpwrspc (Dynamic power spectrum of North-South magnetic field at Kagoshima)
- mm210\_mag\_kag\_1min\_hdz\_y\_dpwrspc (Dynamic power spectrum of East-West magnetic field at Kagoshima)
- mm210\_mag\_kag\_1min\_hdz\_z\_dpwrspc (Dynamic power spectrum of Vertical magnetic field at Kagoshima)

Numerical Data [Geomagnetic Equatorial Dst Index Provisional](#)

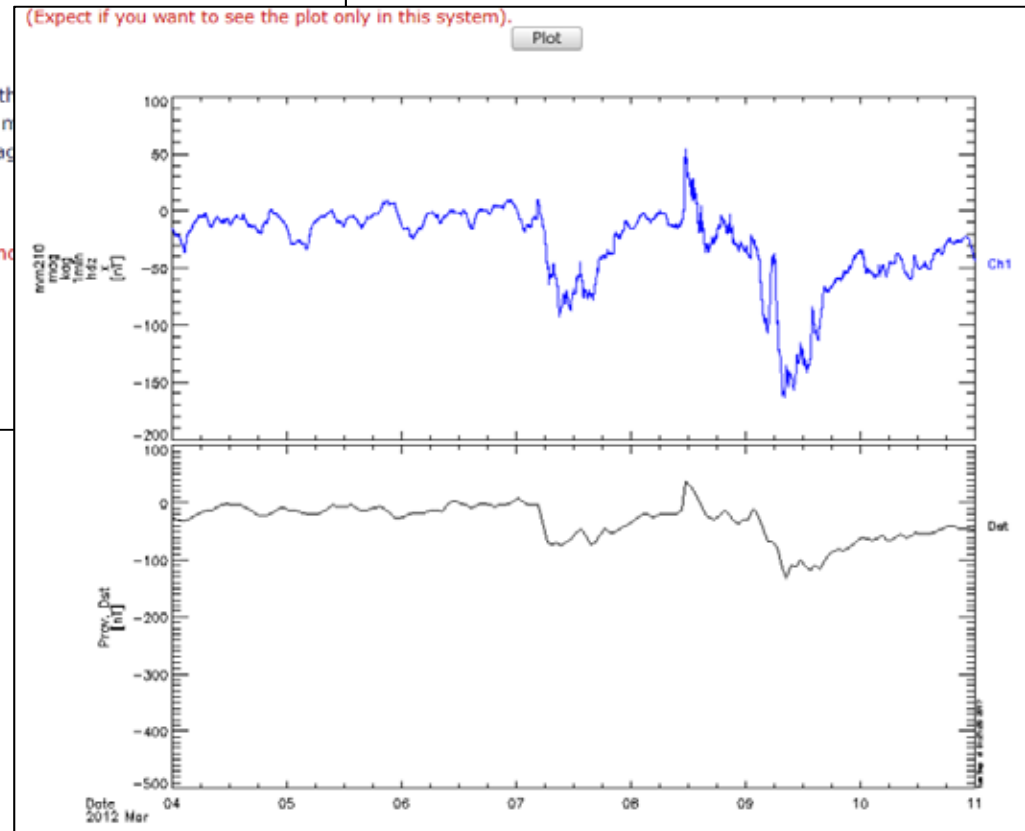
- wdc\_mag\_dst\_prov (Disturbance storm time (Dst) index (provisional))

\* At Least, one variable should be chosen.  
Attention: To create plot image requires some observational data, so read each acknowledgment.  
(Expect if you want to see the plot only in this system).

Plot

All Rights Reserved IUGONET  
Copyright (c) 2009-2012

Select data that you want to plot, then click "Plot".

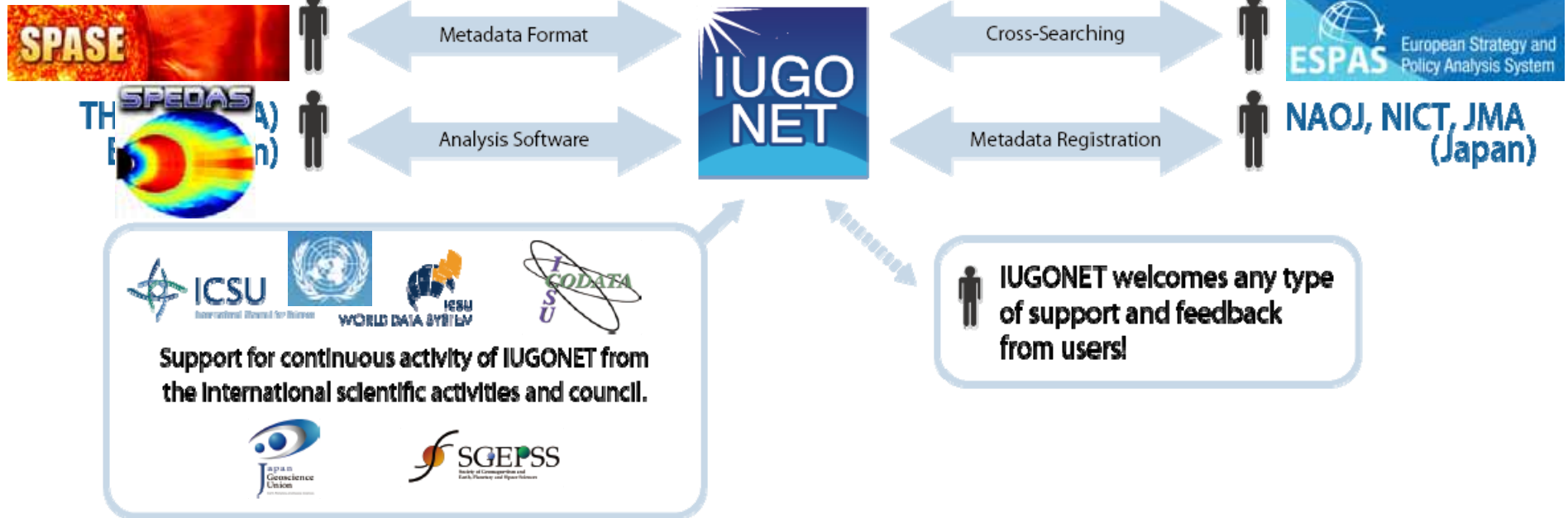


The other institutes and universities in the Japanese STP community.

Japanese Geoscience Group

STP community in the Asia/Oceania/ Africa countries

NASA/Virtual Observatory (VMO, VHO, VWO,...)





at Covenant Univ. in Nigeria  
(Sep. 2017)



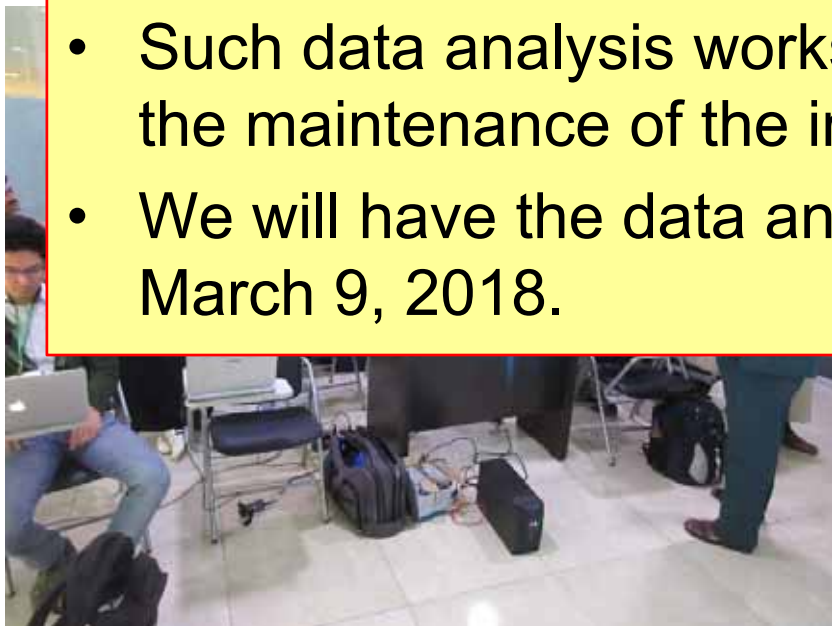
We had data analysis workshop during the 2<sup>nd</sup> International School on Equatorial and low-latitude ionosphere (ISELLI-2) at Covenant University in Nigeria.

Participants: 38 graduate students.





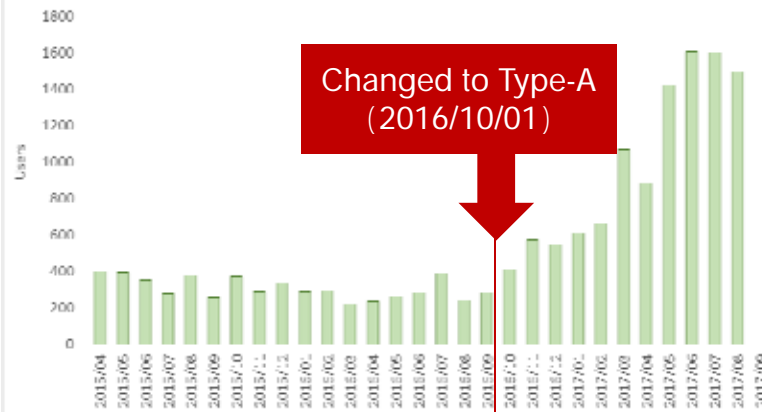
- In order to diffuse the use of our tools and data and also promote research collaboration, we hold data analysis workshops several times a year.
- IUGONET tools are often useful for **capacity building**.
- Such data analysis workshops enhance the motivation of the maintenance of the instruments.
- We will have the data analysis workshop in Indonesia on March 9, 2018.



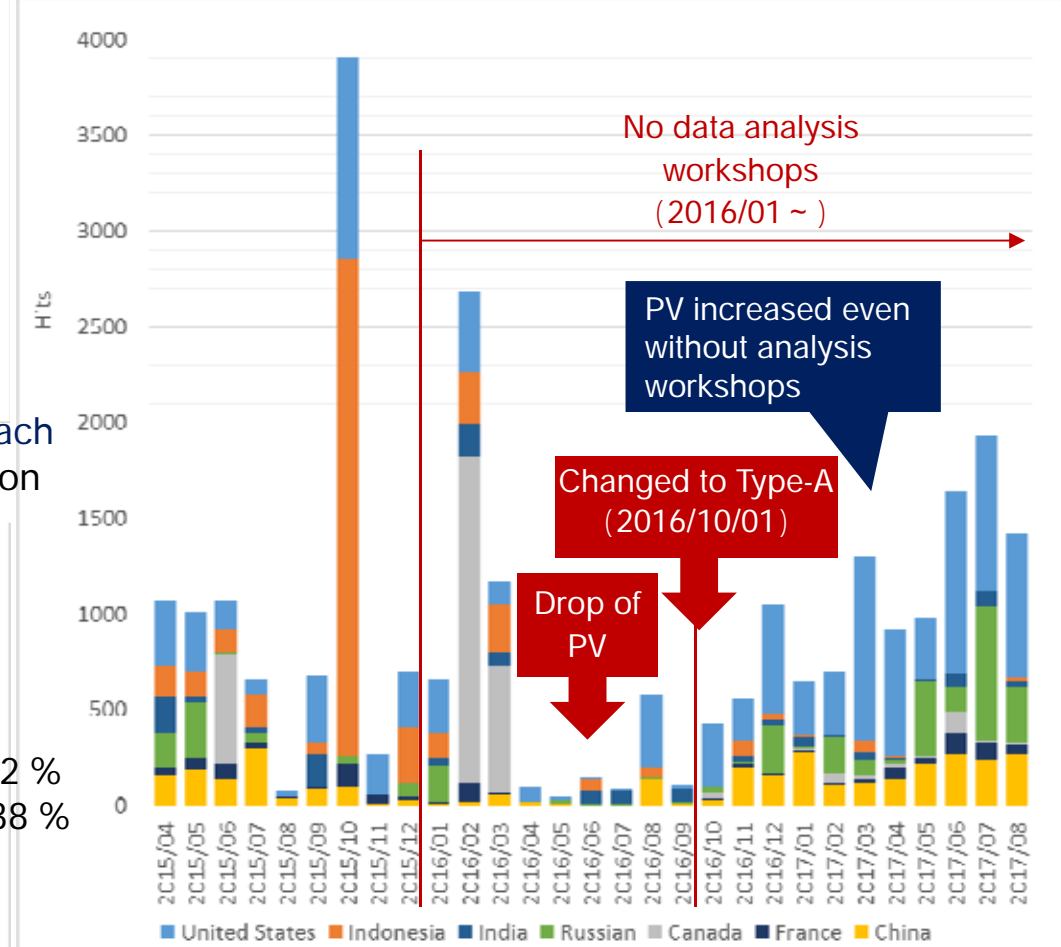
and low-latitude ionosphere (ISELLI-2) at Covenant University in Nigeria.

Participants: 38 graduate students.

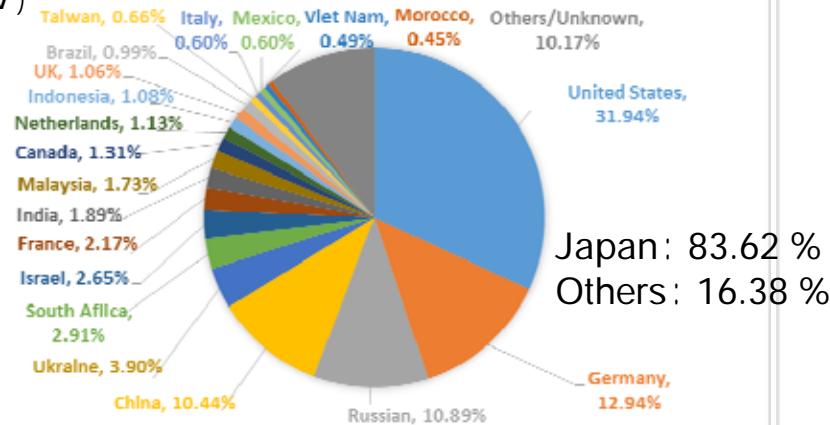
Number of unique users



Number of Page Views (by main foreign countries)



Percentage of website visits accounted for by each country without Japan (2016.10-2017-9, based on PV)



Changes associated with the change into IUGONET Type-A

1. Increase of the number of visitors on the database (about 300→1,500 /month).
2. Mainly, the access from Japan increased. United States became the foreign country that shows the largest number of visitors.
3. The access from foreign countries also increases gradually. → **Outreach (i.e., workshop) is important!**

## These tools allowed users to

- quickly produce research results. (For example, it is often possible to write papers about the campaign observation within one year after the observation).
- analyze **long-term observational data** more than 30 years [e.g., Shinbori et al., 2017]
- comprehensively analyze data obtained by **many types of instruments at globally distributed observatories** [e.g., Takahashi et al., 2017].
- enhance activities of both **young scientists and senior scientists**. (Even senior scientists can conduct their researches and write the papers using these tools [e.g., Sato et al., 2015; 2017; Noersomadi et al., 2017].)



- The IUGONET project has developed the infrastructure for upper atmospheric research, such as the metadata database (**IUGONET Type-A**) and data analysis software (**SPEDAS**).
- IUGONET Type-A provides **a one-stop web service** to search data, find data (and interesting events), know data, examine data, and guide to advanced analysis. We believe that it should be useful to share data and develop the upper atmospheric science.
- These tools are making an effect on outcome, for examples, they help to quickly produce research results, carry out comprehensive analysis, and enhance activities of young scientists and senior scientists.