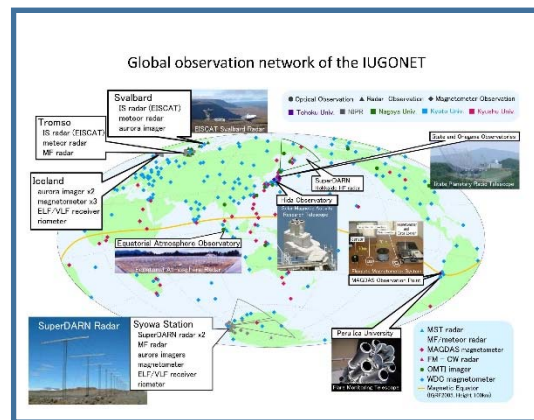
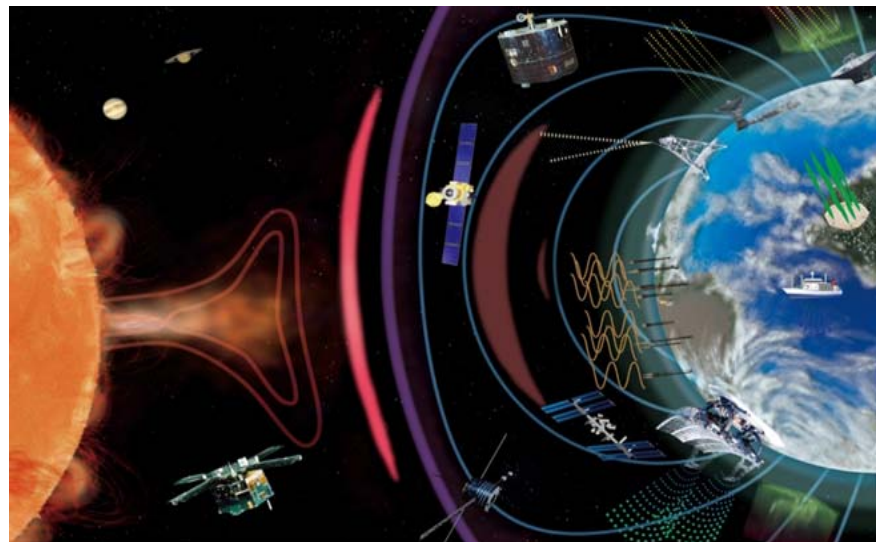
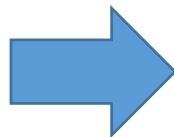


# IUGONETおよびULTRA-IUGONET(計画) における国際連携

家森俊彦・塩川和夫・中村卓司・小原隆博・湯元清文・津田敏隆・  
柴田一成・笠原禎也・篠原育・高橋幸弘・吉川顕正  
および  
IUGONET 開発者チーム・Bernd Ritschel



IUGONET



ULTRA-IUGONET

## IUGONETにおける国際連携

IUGONET: Inter-university Upper-atmosphere Global Observation NETWORK  
(2009-2015 MEXT project by 4 universities and a national institution)

1. 個々の観測あるいはデータベース構築段階での国際共同  
(例) EISCAT, WDC, etc.
2. メタデータ形式(SPASE)導入・拡張・利用段階での協力
3. 解析システム(UDAS)構築段階での協力
4. ESPASとの協力協定と統合検索手法の開発研究

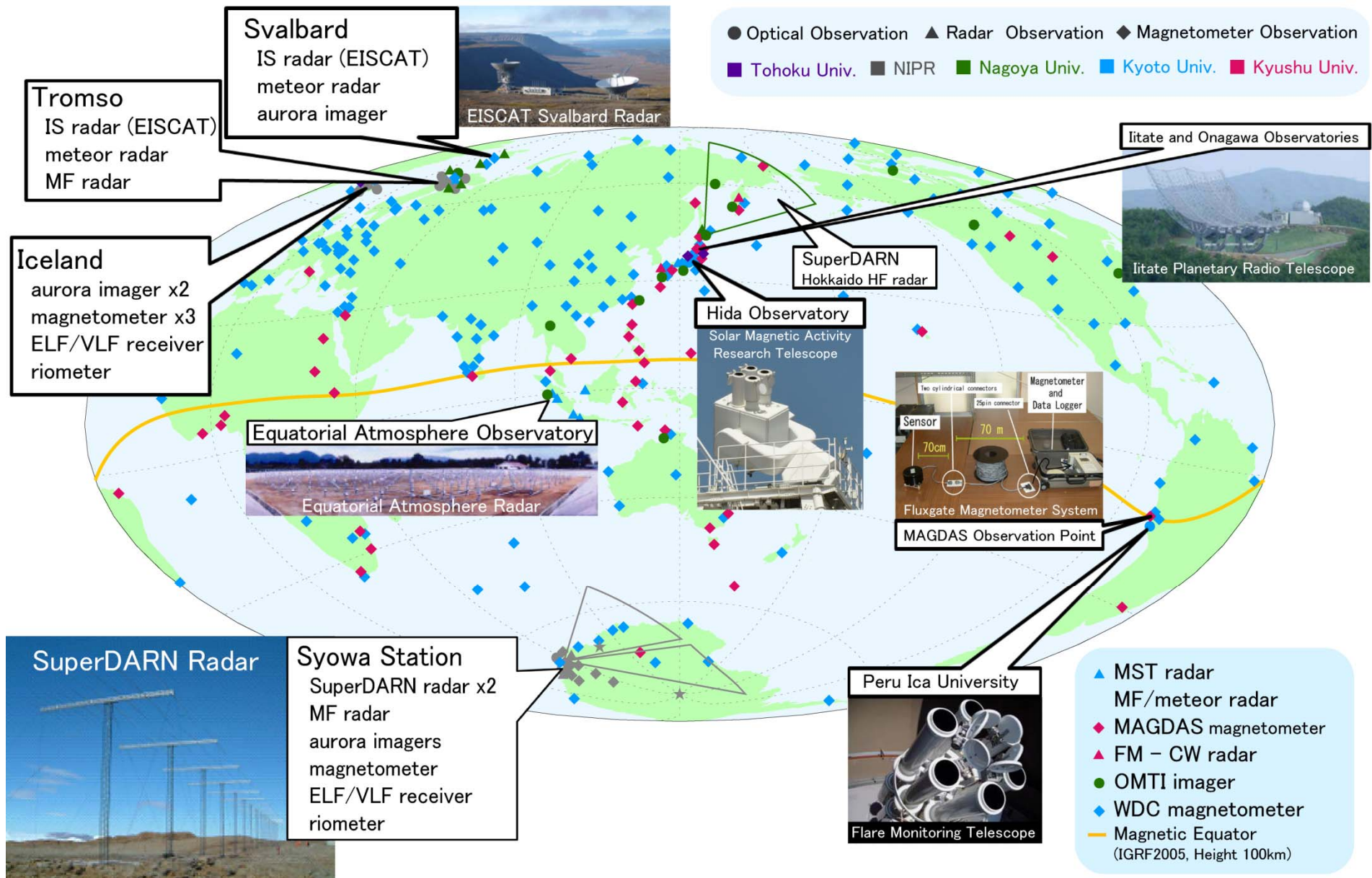
## ULTRA-IUGONETにおける国際連携 (計画)

ULTRA-IUGONET: ULTimate Research Aid – IUGONET

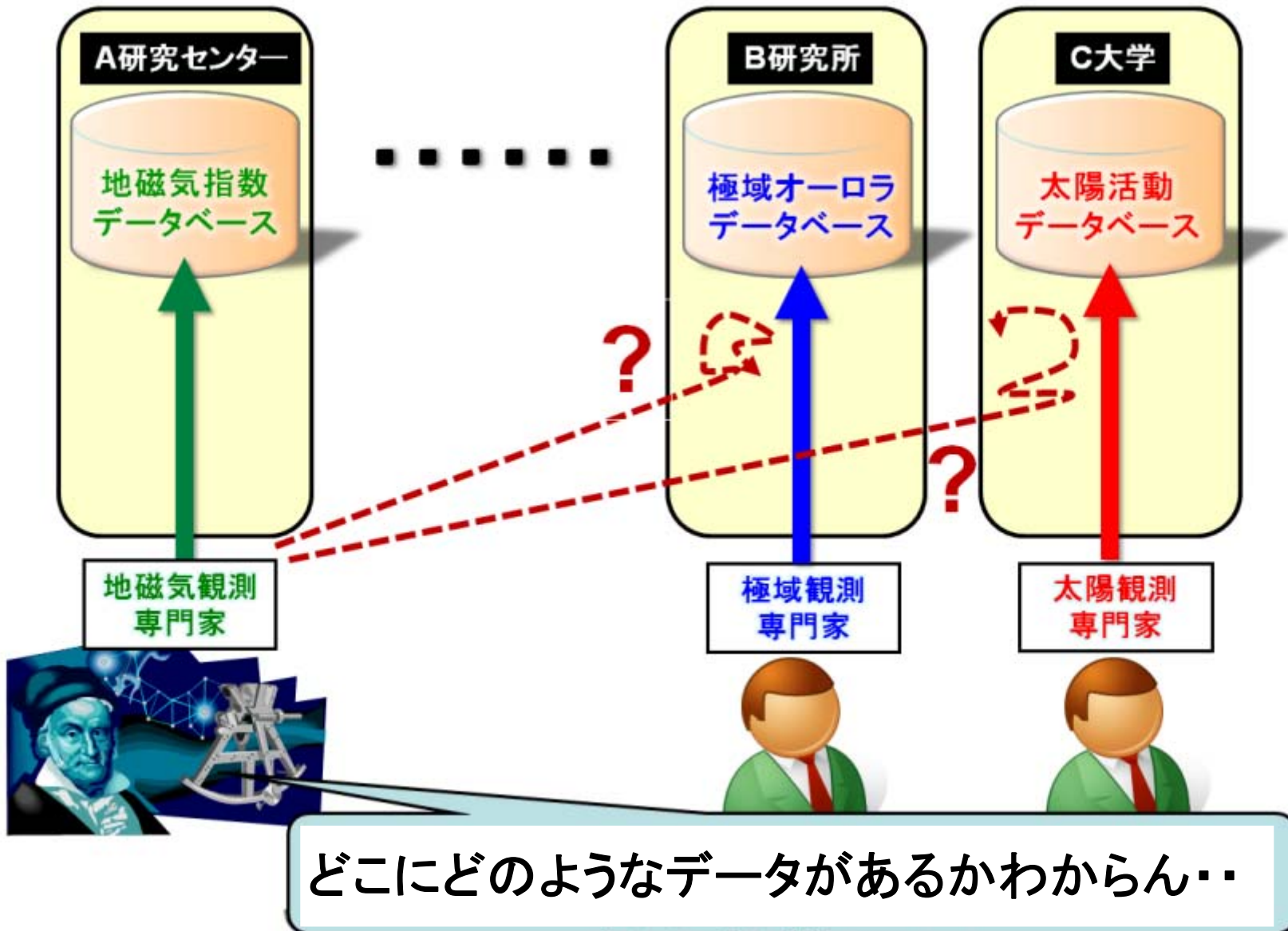
(A proposal to the MEXT by 6 universities and two national institutions)

1. 共通データ検索システムの開発
2. データ交換・解析システムによる統合的利用  
すなわち、**データシステム間の連携**が中心課題  
(**↔** IUGONETは国内データベース間の連携)

# 観測あるいはデータベース構築段階での国際共同



# IUGONET project 開始時点 (2009)



Basic idea: Constructing a **common metadata database** and Use **de-fact standard software** as much as possible

## Metadata Database and search system

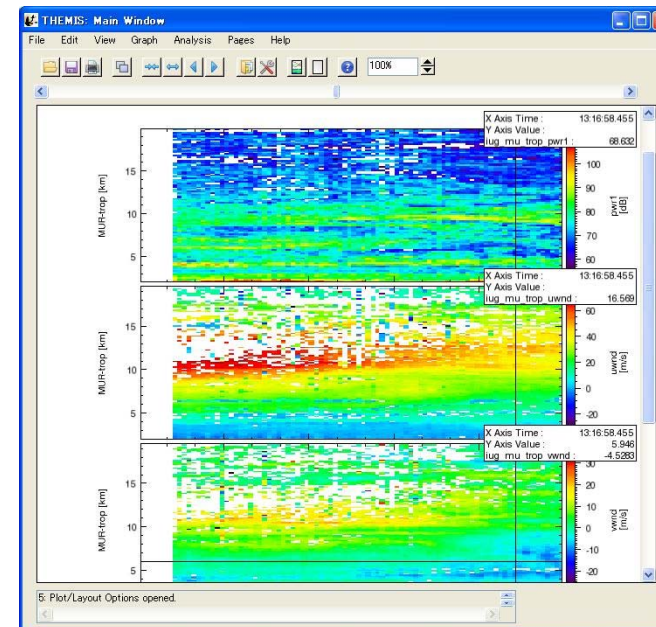


The screenshot shows the IUGONET Metadata DB search system interface. It features a navigation menu on the left with links for Home, IUGONET MDB Search Help, Browse Data (Entire Data / Resource, Resource Type), Browse Service (Browse Service), and UDAS (Iugonet Data Analysis Software). The main search area includes a search bar with a "Free Word" input field, a "Time" range selector, and "Data Types" checkboxes for Numerical, Plot / Movie, Data File / Plot, and Instrument. A "Search" button is located at the bottom of the search area. The interface also displays RSS Feeds and a copyright notice at the bottom: "Copyright © 2009-2011 IUGONET - Feedback Customized by IUGONET."

“SPASE” data model for metadata and “DSpace” for dataset search

<http://search.iugonet.org/iugonet>

## Analysis Software (UDAS)

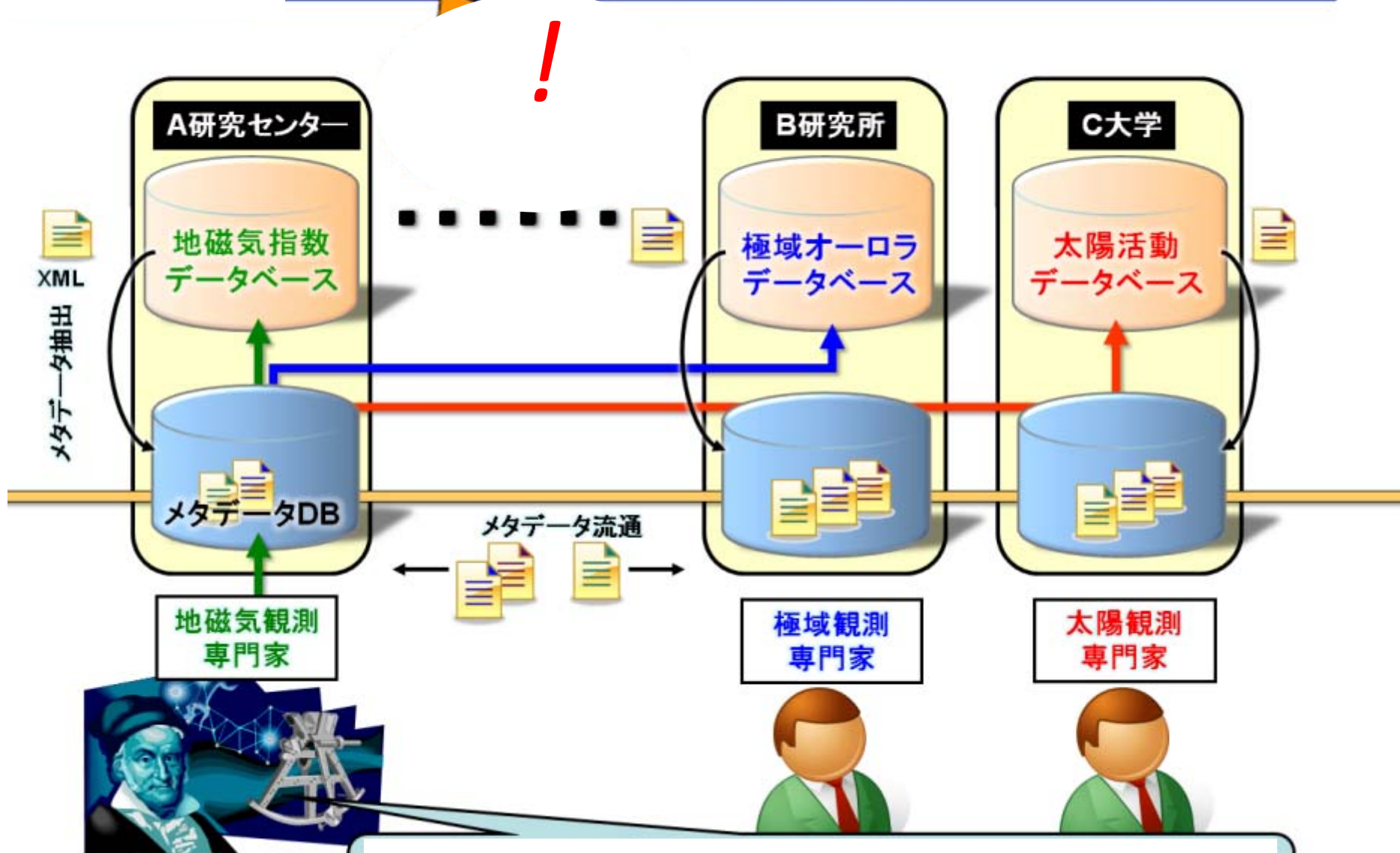


THEMIS analysis software  
“TDAS” with extension for ground based observation

<http://www.iugonet.org/software.html>

present

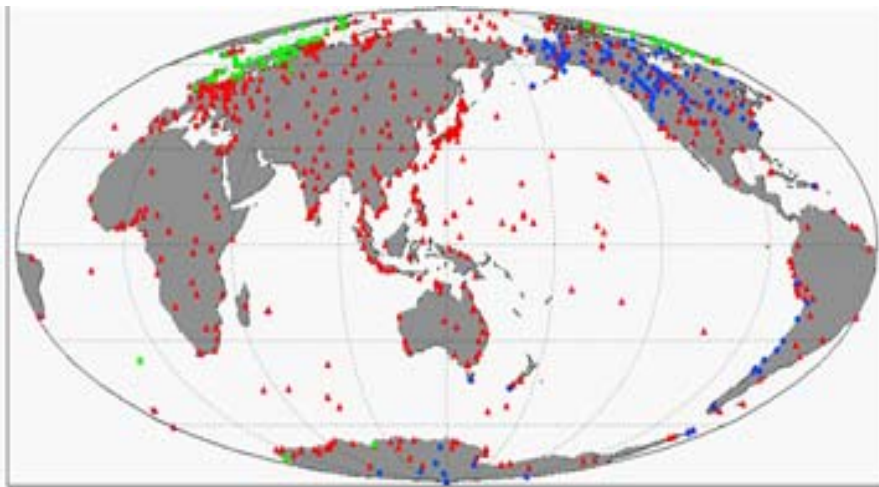
# メタデータを活用した観測データベース利用



こんなデータがあったのか! 並べてみよう...

衛星観測データと国際化の必要 → JAXAおよび 欧米 システムと協力不可欠

- IUGONET は地上観測データのみを取り扱ってきたが、太陽地球系科学にとって、衛星観測データは不可欠。
- 衛星観測データも多種多様大量データが分散して存在。所在の把握が困難。
- 特に、海外のデータシステムについては、**地上観測も含め**、データの所在把握が難しい。



Red: IUGONET, Blue: US/Canadian databases  
Green: European databases

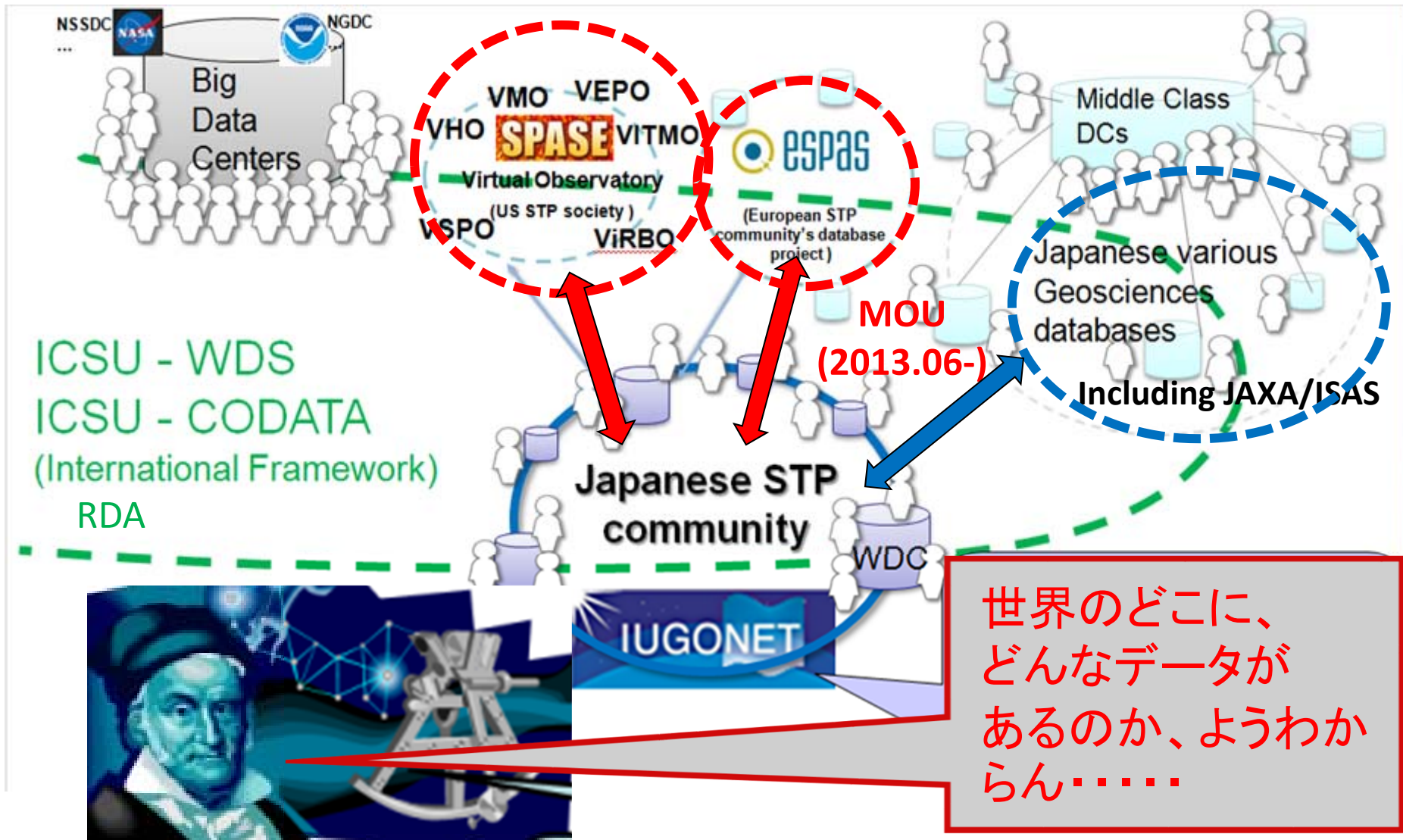


Wide variety of satellite data

← There must be much more for blue and green – We (IUGONET) do not know!

# 国際的に分散したデータシステム

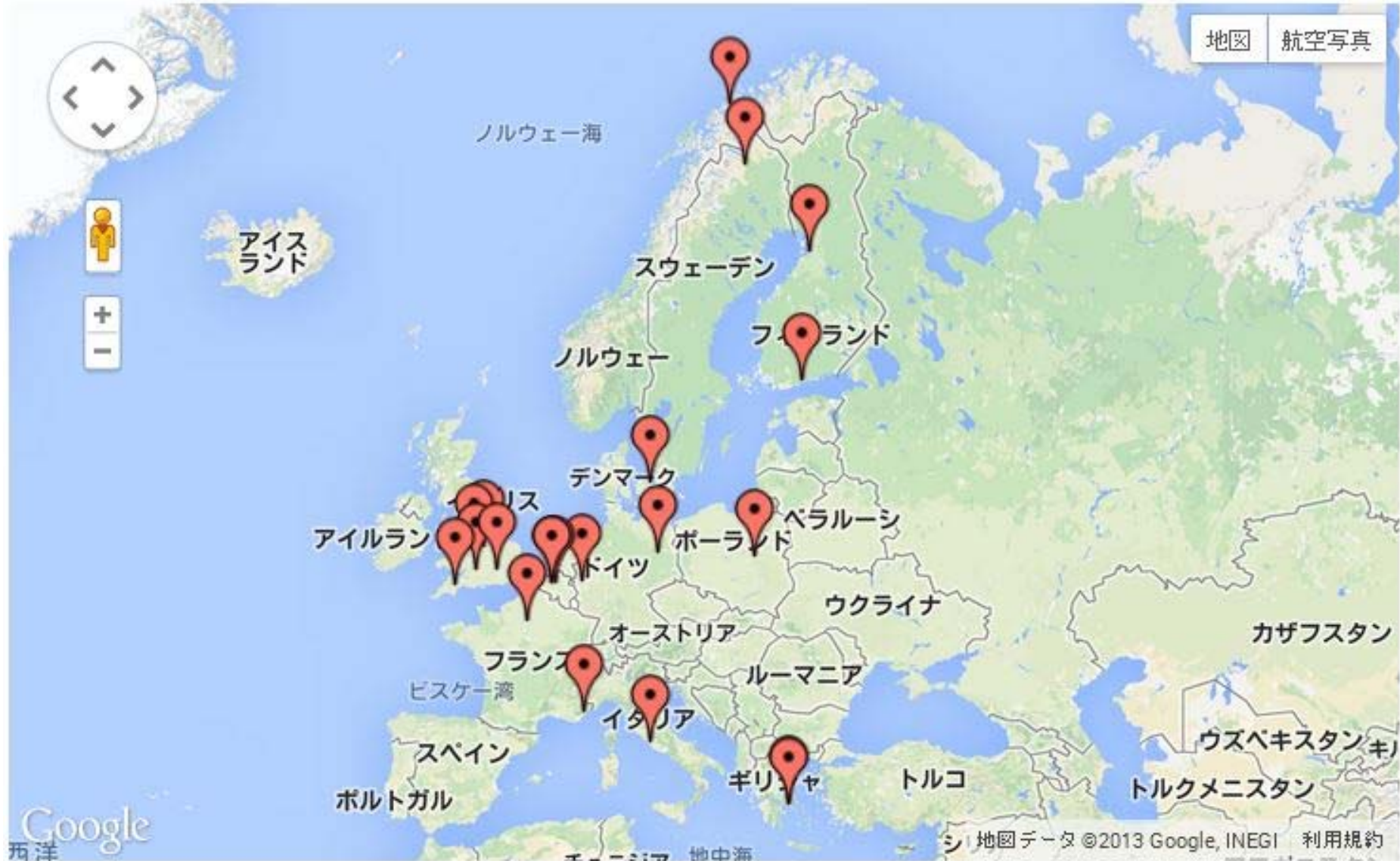
→ interoperabilityの拡張推進が重要





# ESPAS 参加組織の分布

(ESPAS: Near Earth Space Data Infrastructure for e-Sciences)



# ESPASで提供しているデータベース (地上観測)

Source	Types of data
Near-Earth space data from ground-based sensors and instruments	
DIAS system	Ionosonde parameters, ionograms, European maps of critical frequencies — 8 Digisondes
ESWUA database	Usable frequencies for HF communications and oblique ionograms
European ionosondes Tromsø, Gibeilmanna, Sodankylä, Warsaw, Hornsund	Vertical sounding parameters and ionograms
EISCAT incoherent scatter radars	Electron density profiles and temperatures from EISCAT
EISCAT dynasondes	Ionosonde parameters, ionograms
Malvern ISR database	Electron density profiles
GIRO databases	Ionograms, skymaps and drift files from 50 Digisondes around the world
SWACI database	TEC GNSS parameters and European maps
SuperDARN	Convection maps
INGV magnetometers	Magnetic field data from three permanent geomagnetic observatories in Italy
SGO magnetometer	Magnetic field data from Sodankylä Geophysical Observatory
DTU Space Magnetometer Network	Magnetic field data from Greenland, Denmark and the South Atlantic — 25 stations
IMAGE Magnetometer Network	Magnetic field data covering geographic latitudes from 58 to 79 degrees — 31 stations
TGO Magnetometer Network	Magnetic field data from Svalbard to the south-west coast of Norway — 14 stations
FPI database	Neutral wind and neutral temperature at 240 km over 3 sites in Scandinavia.

# ESPASで提供しているデータベース（衛星観測）

Near-Earth space data from space-borne sensors

CLUSTER	In situ electron density
DEMETER	In situ electron density
SWACI database : CHAMP and GRACE	Reconstructed electron density profiles and RO profiles
CHAMP ATMO	Neutral Atmosphere data
FORMOSAT-3/COSMIC	Electron density profiles, RO data, TEC data
MAGION-3 database	ELF/MLF wave experiment data. PRS-3 synthesizer radiospectrometer data. Data from cold thermal plasma in the topside ionosphere. High-energy charged particle spectrometer data.
GIRO database: IMAGE/PRI	Plasmagrams from Radio Plasma Imager
ACE	Interplanetary magnetic field, solar wind density and velocity
SOHO LASCO	coronagraph observations
PROBA2	Data from SWAP coronal imager Data from LYRA EUV radiometer
NOAA/POES	Calibrated and homogenized fluxes of energetic particles
ISIS/Alouette database	Electron density profiles

## NASA/Virtual Observatories - SPASEフォーマットを使用

- ◆ Heliophysics Data Portal (<http://heliophysicsdata.gsfc.nasa.gov/>)
- ◆ Virtual Heliospheric Observatory (VHO) (<http://vho.nasa.gov/>)
- ◆ Virtual Energetic Particle Observer (VEPO)  
(<http://vepo.gsfc.nasa.gov/>)
- ◆ Virtual Magnetospheric Observatory at Goddard (VMO/G)  
(<http://vmo.nasa.gov/>)
- ◆ Virtual Magnetospheric Observatory at UCLA (VMO/U)  
(<http://vmo.igpp.ucla.edu/>)
- ◆ Virtual Model Repository (VMR) (<http://vmr.engin.umich.edu/>)
- ◆ Virtual Radiation Belt Observatory (ViRBO) (<http://virbo.org/>)
- ◆ Virtual Wave Observatory (VWO) (<http://vwo.gsfc.nasa.gov/>)
- ◆ Magnetogram Analysis for the Network of Geophysical  
Observatories (MANGO) (<http://mango.igpp.ucla.edu/>)

## SPASE Consortium Participants

- Augsburg College
- California Institute of Technology (CalTech)
- Centre de Données de la Physique des Plasmas (CDPP)
- Istituto Nazionale di Astrofisica (INAF)
- Japan Aerospace eXploration Agency (JAXA) - STP/Ehime
- Japan's Inter-university Upper atmosphere Global Observation NETwork (**IUGONET**)
- Jet Propulsion Laboratory (JPL)
- John Hopkins University/Applied Physics Laboratory (JHU/APL)
- George Mason University
- Goddard Space Flight Center (GSFC)
- National Aeronautics and Space Administration (NASA) HQ
- National Oceanic and Atmospheric Administration (NOAA)
- NOAA's National Geophysics Data Center (NGDC)
- Rutherford Appleton Laboratory (RAL)
- Stanford University
- Southwest Research Institute (SwRI)
- University of California, Los Angeles (UCLA)

# データシステム間のInteroperabilityの拡張・推進

## 問題点

- ・ 各データシステムで用いているデータモデル (オントロジー) が異なる → 共通検索の困難
- ・ データポリシーの相違

## 解決方法 (IUGONET ↔ ESPAS の場合)

- ・ 異なるデータモデル間のオントロジーの変換 (ボキャブラリの統一(対応付け)を含む)
- ・ メタデータの交換・共通検索からスタート

## 目標

- ・ 共通検索方法の開発 (IUGONET, ESPAS, NASA/VOs)
- ・ ダウンロード/プロット・解析ソフトの開発

# Promotion of the collaboration with **ESPAS** and **IUGONET** (ESPAS: Near Earth Space Data Infrastructure for e-Sciences)

IUGONET (SPASE) と ESPAS (ISO) は、異なるデータモデルを使用している。

SPASE ontology



ESPAS ontology

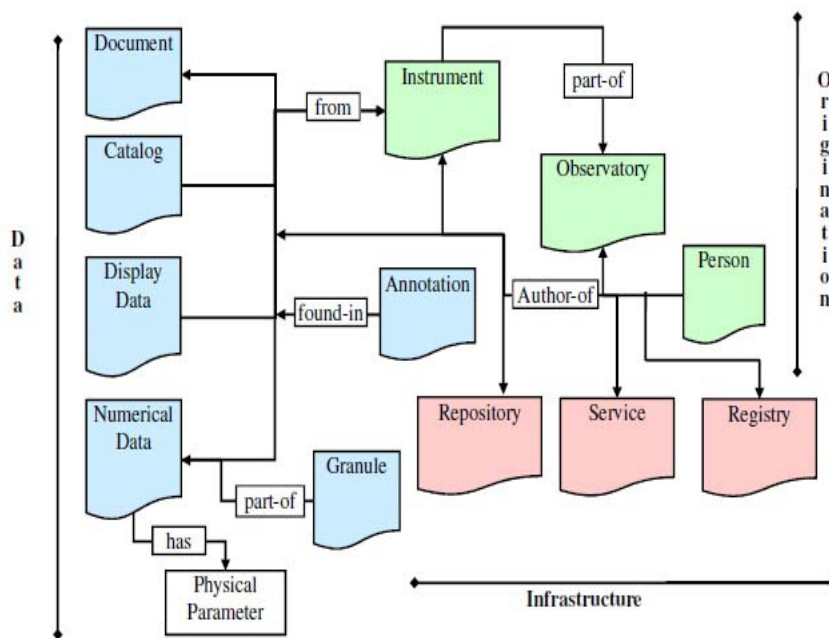
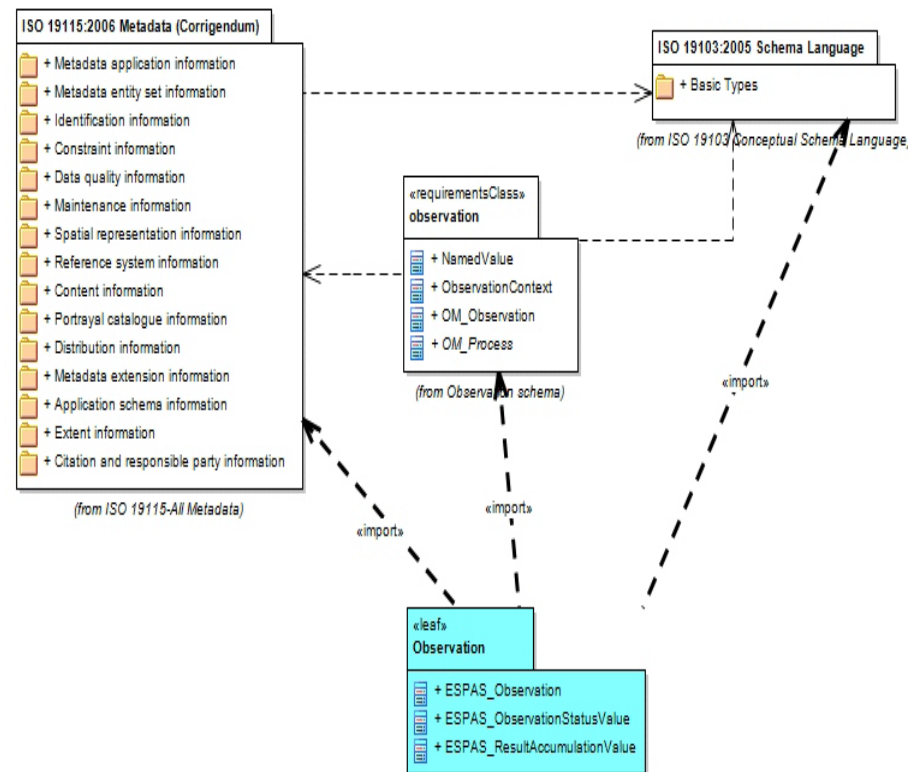


Figure 2: The association map between resources in the SPASE model. Arrows point in the direction of association.



データ所在情報把握の困難と、分散したデータ利用の必要性は、分野を超えて**世界共通の問題意識**となっている。

a **AGU Fall Meeting** session ID#: **3949**

“Mash-up of Heterogeneous Data Systems for Better Data Integration: Furthering Interoperability through Collaborative Communities”

Primary Convener: Bernd Ritschel,

Co-conveners: Peter A. Fox, Christine E. White and Toshihiko Iyemori



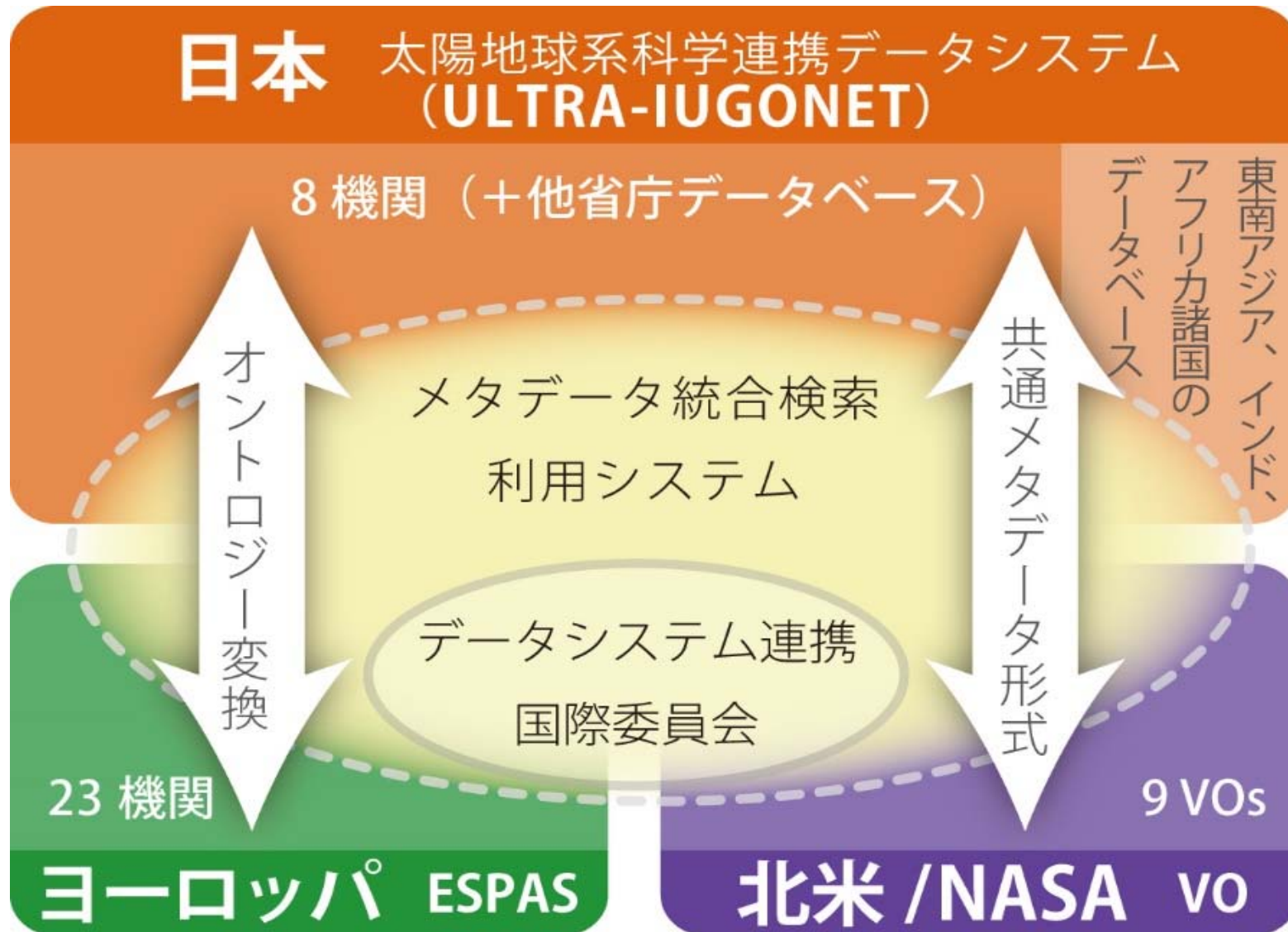
- ・ 国際的な情報交換、共同の可能性を見つけ出す試みの一つ
- ・ 分野交流による新たな手法の出現・最適な手法の選択



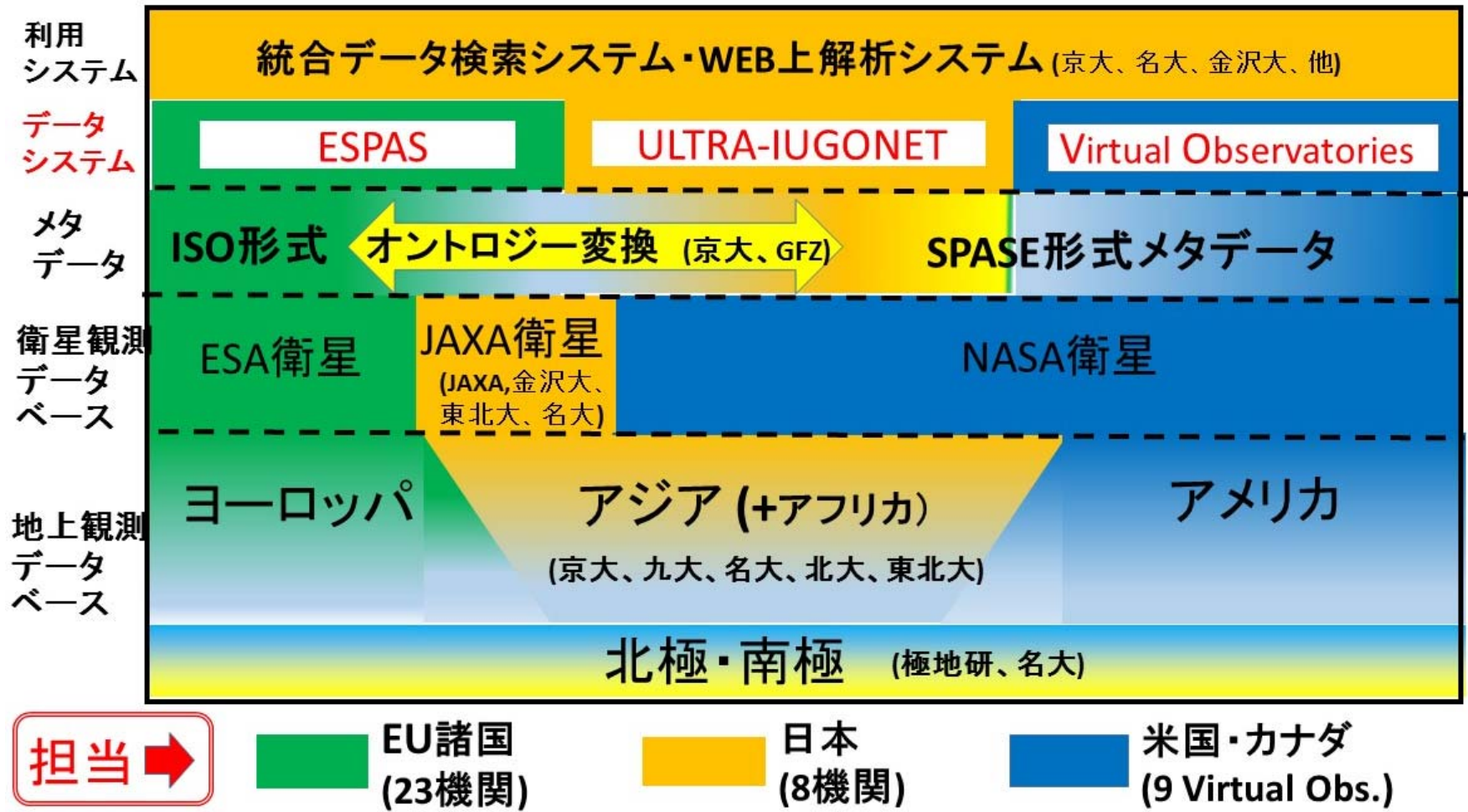
H27概算要求における国際会議の提案



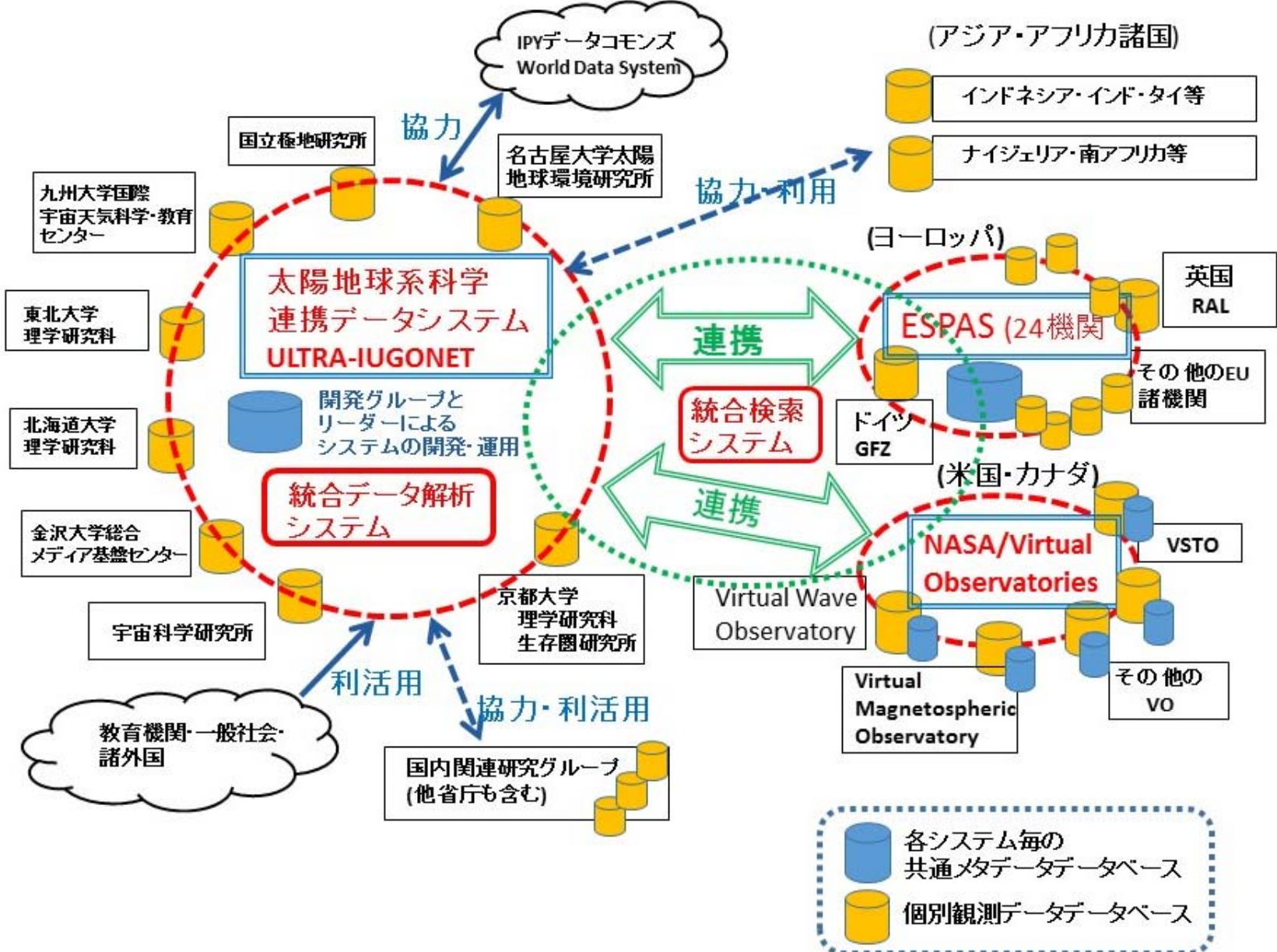
# H27 概算要求におけるデータシステム国際連携の提案



# 国際連携における役割分担



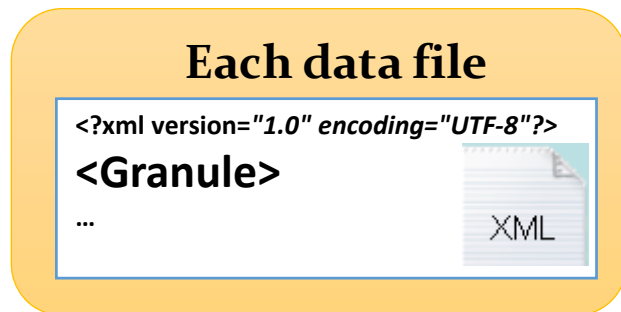
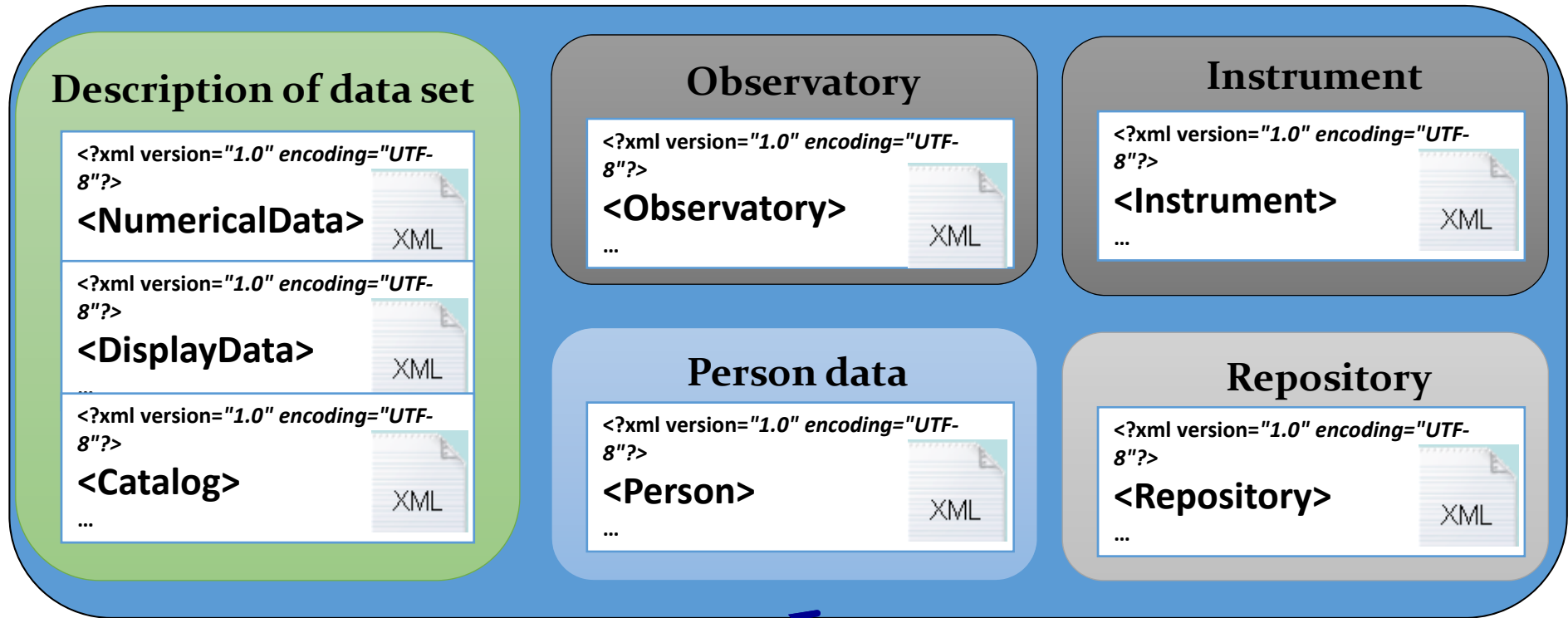
# 全体のシステム構成



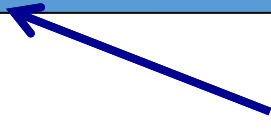
終わり

(以下は予備スライド)

# IUGONET Metadata (SPASE)のフォーマットと構造



**Data set**



# メタデータの例: NumericalData

```
<?xml version="1.0" encoding="UTF-8"?>
<Space lang="en" xmlns="http://www.3org/200/3/XMLSchema-instance" xmlns:xsi="http://www.ugonet.org/data/schema"
xsi:schemaLocation="http://www.ugonet.org/data/schema http://www.ugonet.org/data/schema/ugonet.xsd">
  <Version>1.0.0/Version</Version>
  <NumericalData>
    <ResourceID>space://UGONET/NumericalData/STEL/SuperDARN/HO/NHFractalId_hok_common_ergscodf/ResourceID</ResourceID>
    <ResourceHeader>
      <ResourceName>SuperDARN Hokkaido HF radar, commonmode data distributed by ERG-00</ResourceName>
      <Description>Commonmode data generated by SuperDARN Hokkaido HF radar. Data files are distributed in the CDF format through ERG-00</Description>
      <Contact>
        <PersonID>space://UGONET/Person/Wakamu.M.H.Ivan</PersonID>
        <Role>Principal Investigator</Role>
      </Contact>
    </ResourceHeader>
    <AccessInformation>
      <RepositoryID>
        <space://UGONET/Reposit by STEL/ERG-00</RepositoryID>
      </RepositoryID>
      <Availability>Online</Availability>
      <AccessRights>Open</AccessRights>
      <AccessURL>
        <URL>http://ergscodf.lelab.jp/ergscodf/URL</URL>
      </AccessURL>
      <Format>CDF</Format>
    </AccessInformation>
    <InstrumentID>space://UGONET/Instrument/STEL/SuperDARN/HO/NHFractal/InstrumentID</InstrumentID>
    <MeasurementType>Dopplergram</MeasurementType>
    <TemporalDescription>
      <TimeSpan>
        <StartDate>2005-12-02T00:00:00</StartDate>
        <RelativeStopDate>P7D</RelativeStopDate>
      </TimeSpan>
      <Calence>P30</Calence>
      <Exposure>P30</Exposure>
    </TemporalDescription>
    <ObservedRegion>
      Earth, Near Surface, Atmosphere F Region
    </ObservedRegion>
    <SpatialCoverage>
      <CoordinateSystem>
        <CoordinateRepresentation>Spherical</CoordinateRepresentation>
        <CoordinateSystemName>GEO</CoordinateSystemName>
        <CoordinateSystem>
          <NorthernmostLatitude>84.0</NorthernmostLatitude>
          <SouthernmostLatitude>30.0</SouthernmostLatitude>
          <EasternmostLongitude>130.0</EasternmostLongitude>
          <WesternmostLongitude>130.0</WesternmostLongitude>
          <UnitDegree>Unit</UnitDegree>
        </CoordinateSystem>
      </SpatialCoverage>
    <Parameter>
      <Name>Max range gate 0</Name>
      <Description>Maximum range gate number for 75 range gate mode, namely 75</Description>
      <Support>
        <SupportQuantity>Temporal</SupportQuantity>
      </Support>
    </Parameter>
  </NumericalData>
  ...
```

Xmlで作成して  
各機関から収集

## Resource ID

全研究リソースに対してuniqueに割り振られるURI形式のID  
space://UGONET/NumericalData/STEL/SuperDARN/HO/NHFractal/sd\_hok\_common\_ergscodf

## Resource Header部

リソースの名前、説明、発行日時、コンタクト情報など

## Access Information部

実データDBの場所、データファイルのフォーマット、アクセス権限などの情報

## Instrument ID, Measurement Type

このデータを取得した観測器に関する情報。観測器自体のメタデータへリンクしている

## Temporal Description部

データが存在する時間範囲、またデータの時間分解能に関する情報

## Observed Region

観測領域に関する情報。この場合は地球電離圏のF層

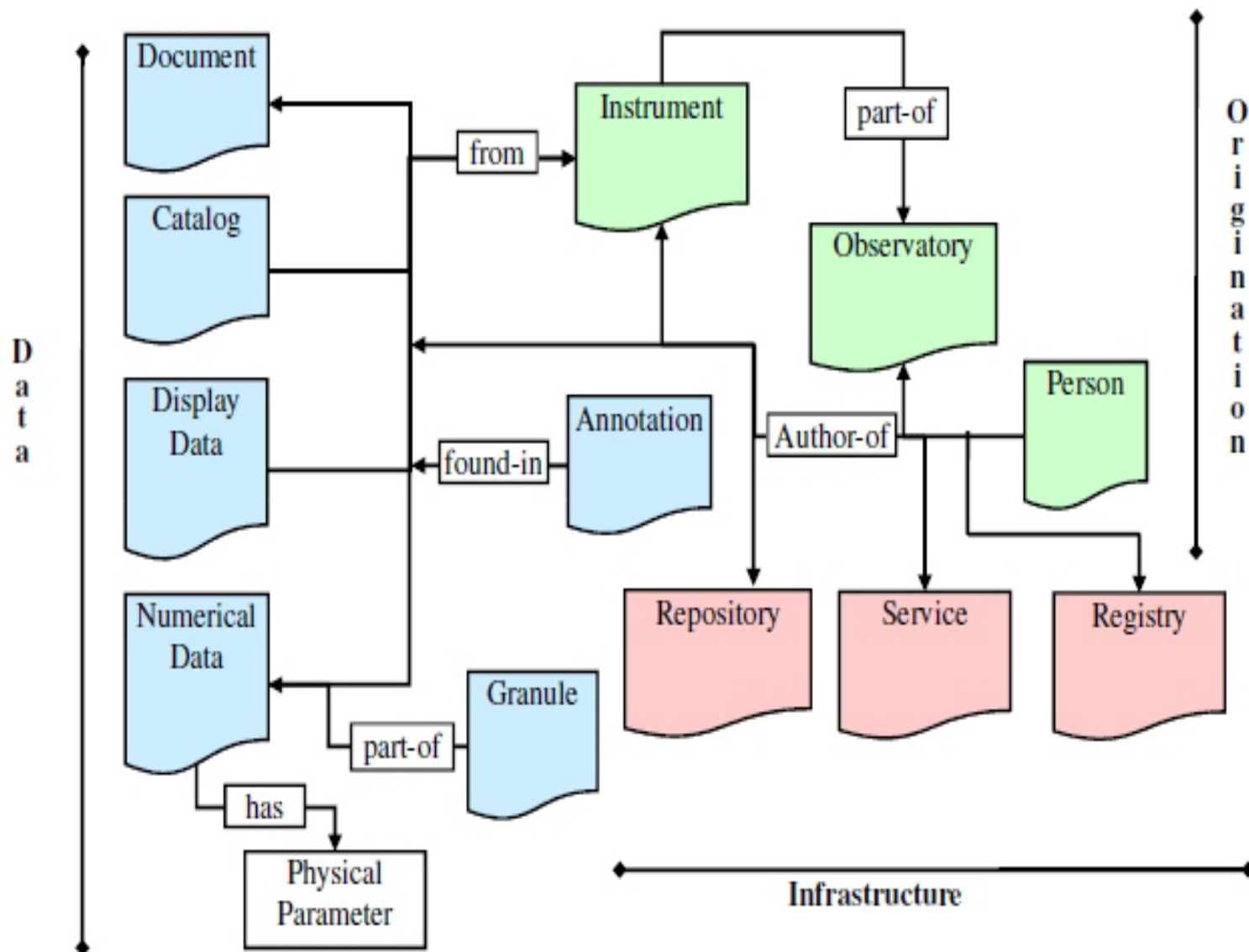
## Spatial Coverage部

観測領域の範囲の緯度・経度・高度等の情報(時刻+)観測範囲での検索に利用

## Parameter部

データとして入っているパラメータに関する情報。パラメータ名、属性、変数配列の構造、など

# SPACE メタデータ間の関連 (オントロジー)



## メタデータフォーマットの策定



機能、使い易さ／他分野、  
他データシステムとの互換

**SPACE PHYSICS ARCHIVE SEARCH AND EXTRACT**

HOME DOCUMENTS DATA MODEL SCHOOL TOOLS SERVICES NEWS CONNECT ABOUT

### Welcome to the SPASE Group

The Space Physics Archive Search and Extract (SPASE) effort is a HelioPhysics community-based project with the goals of

- Facilitating data search and retrieval across the Space and Solar Physics data environment with a common metadata language
- Defining and maintaining a standard Data Model for Space and Solar Physics interoperability, especially within the HelioPhysics Data Environment
- Using the Data Model to create data set descriptions for all important HelioPhysics data sets
- Providing tools and services to assist SPASE data set description creators as well as the researchers/users
- Working with other groups for other HelioPhysics data management and services coordination as needed

The Space Physics Archive Search and Extract (SPASE) effort is implemented by the SPASE Consortium which is composed of representatives of the international HelioPhysics data community. The SPASE Working Group is currently the only international group supporting global data management for Solar and Space Physics.

[Learn more](#) about the SPASE group.

### Products

The SPASE Group generates three "products". First is the **SPASE Metadata Model** which is an information model for describing the elements of the helioPhysics data environment. Second is a set of **services** and protocols to enable the exchange of information. Third are **tools** for developing and validating resource descriptions.

A complete set of **documentation** is also available.  
[Tutorials](#) and instructions are available at the [SPASE School](#).

**Data Model Document**

[Current Version \(2.2.0\)](#)  
Released: 2011-01-06  
[All documents](#)  
[History of changes](#)

**Schemas**

[Current Release \(2.2.0\)](#)  
updated: 2011-01-05  
[View all versions](#)

**Tools**

[Data Dictionary Search](#)  
[Data Model Tree](#)  
[Data Model Explorer](#)

**Registry Server**

[Resource ID creator](#)  
[Editor \(web\)](#)  
[XML Validator](#)

**Services**

[SMWG Registry](#)  
[Naming Authority List](#)

**Looking for:**

[Vintage web site](#)

NASA Goddard Space Flight Center  
HelioPhysics Physics Laboratory, Code 572  
Greenbelt, MD 20771

Curator: Todd King, Dr. Edwin Bell, II  
NASA Official: Dr. James R. Thomson  
+ NASA Privacy, Security, Notices

## Space Physics Archive Search and Extract (SPASE) を採用

NASA, 米国の大学・研究機関及びヨーロッパの関連機関からの研究者から成るコンソーシアムで策定・随時update

基本的に太陽、惑星間空間、地球磁気圏の人工衛星観測データを念頭に、それらに関連する研究リソースを包括的に表現するデータモデルに基づいて作られた、メタデータフォーマット

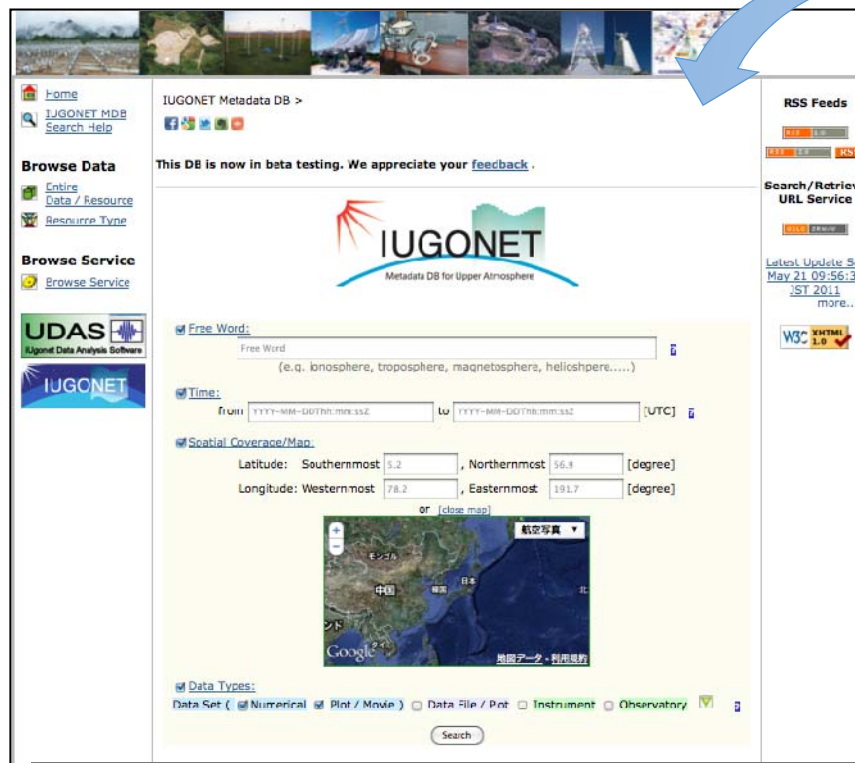
NASA関係機関構成している  
VxO (Virtual xxxxxxxx  
Observatories) が使用している。



- IUGONET uses **DSpace** as the metadata DB platform

## Development of metadata DB system

- ✓ Free software, widely used by digital repositories in many universities over the world.
- ✓ Including fundamental functions to register, search, provide, and harvest metadata written even in the IUGONET metadata format.



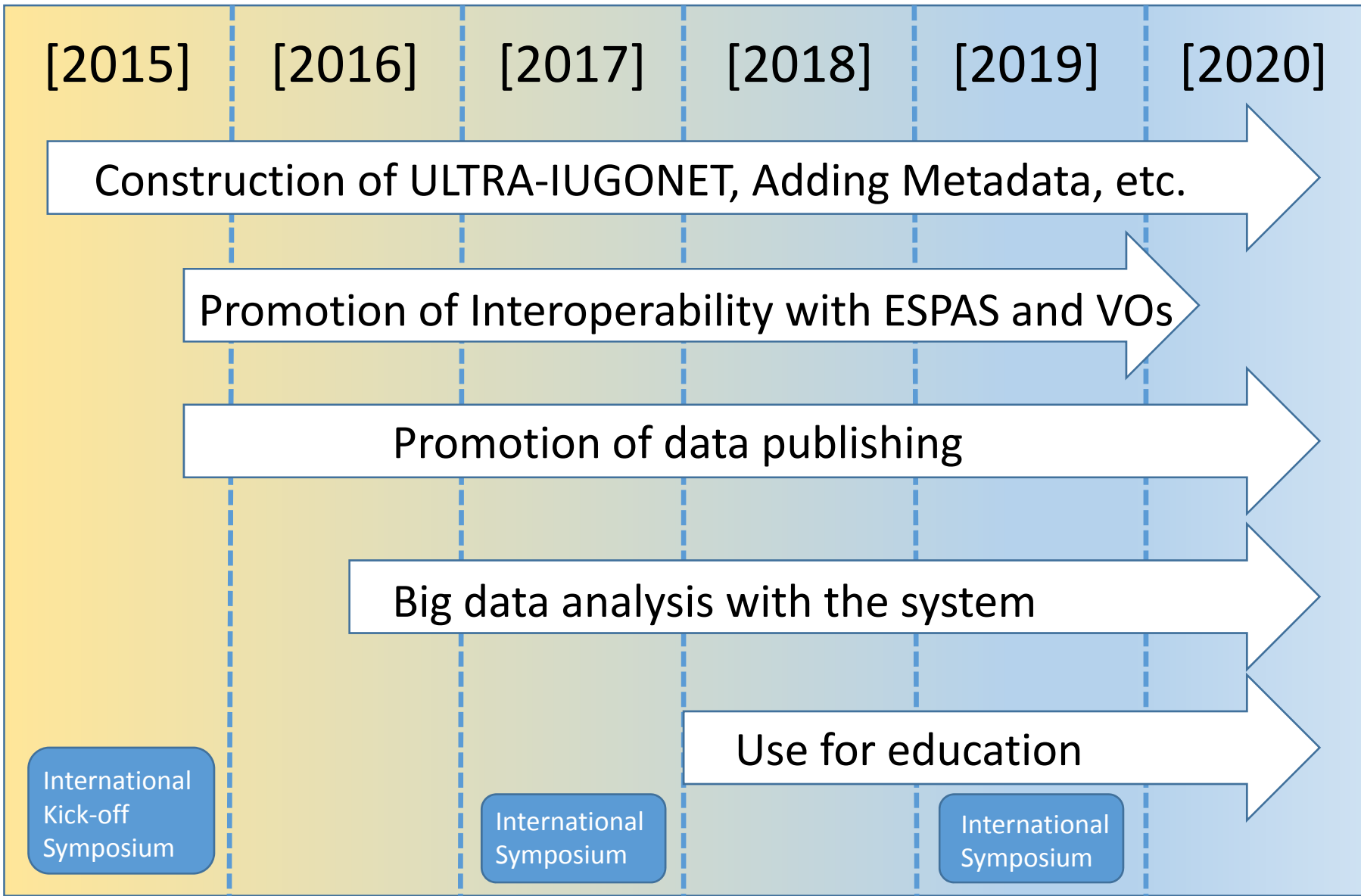
registered

XML

```
<?xml version="1.0" encoding="UTF-8"?>
<space lang="en" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://www.iugonet.org/data/schema"
xsi:schemaLocation="http://www.iugonet.org/data/schema
http://www.iugonet.org/data/schema/iugonet.xsd ">
<Version>1.0.0</Version>
<NumericalData>

<ResourceID>spase://IUGONET/NumericalData/STEL/SuperDARN/HOK/HFradar/sd_hok_common_ergscdf</ResourceID>
  <ResourceHeader>
    <ResourceName>SuperDARN Hokkaido HF radar, common mode data distributed by ERG-SC</ResourceName>
    <ReleaseDate>2009-04-01T00:00:00</ReleaseDate>
    <ExpirationDate>2199-12-31T23:59:59</ExpirationDate>
    <Description>Common mode data generated by SuperDARN Hokkaido HF radar. Data files are distributed in the CDF format through ERG-SC</Description>
    ...
    ...
  </NumericalData>
```

>About 2000 metadata of datasets are available for now !



[2015]

[2016]

[2017]

[2018]

[2019]

[2020]

Construction of ULTRA-IUGONET, Adding Metadata, etc.

Promotion of Interoperability with ESPAS and VOs

Promotion of data publishing

Big data analysis with the system

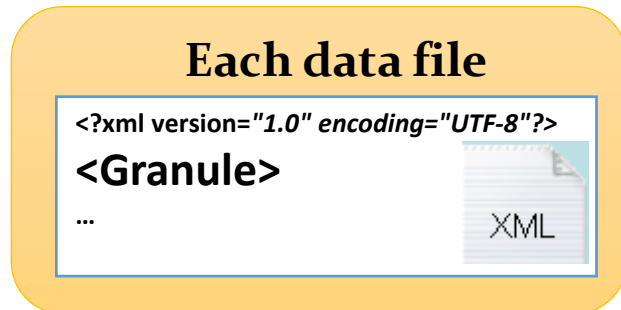
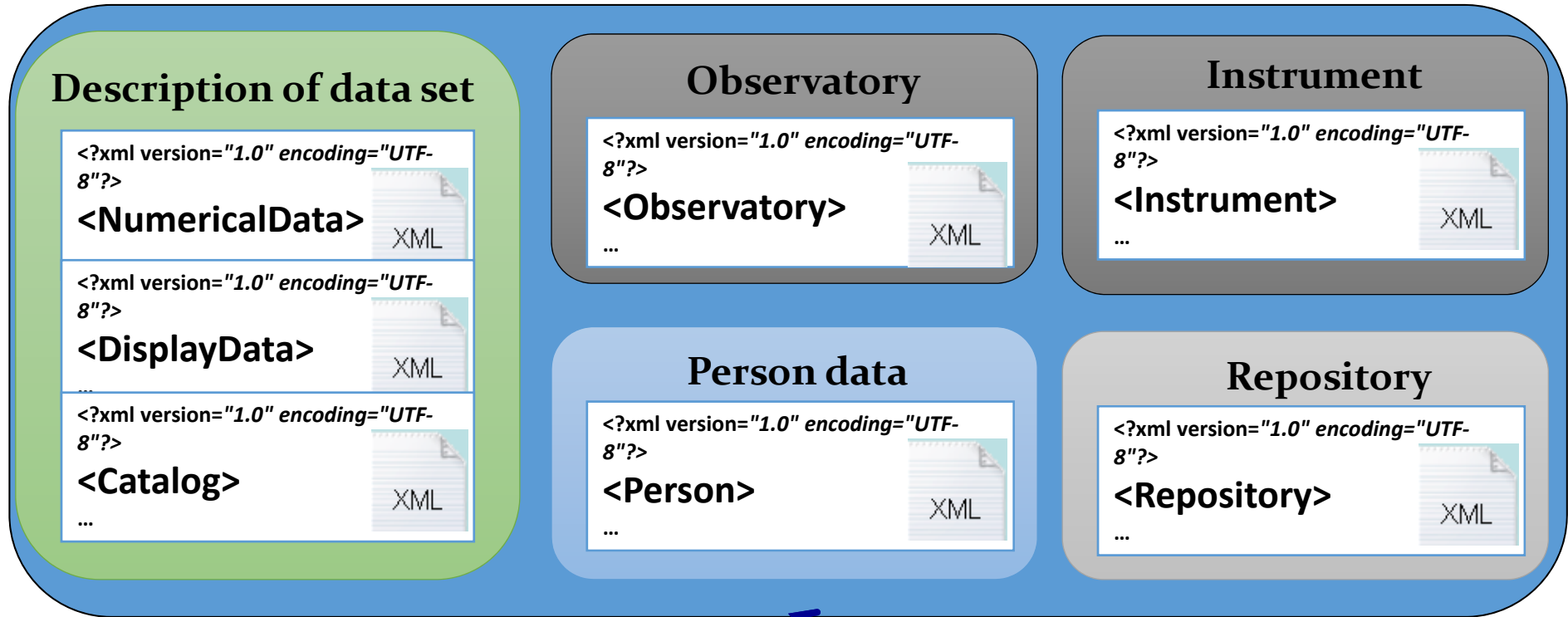
Use for education

International Kick-off Symposium

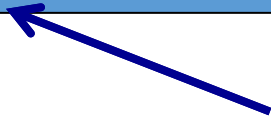
International Symposium

International Symposium

# IUGONET Metadata (SPASE)のフォーマットと構造



**Data set**



# メタデータの例: NumericalData

```
<?xml version="1.0" encoding="UTF-8"?>
<Space lang="en" xmlns="http://www.3gov/2007/XMLSchema-Instance" xmlns:xsi="http://www.3gov.org/2007/XMLSchema-Instance" xsi:schemaLocation="http://www.3gov.org/2007/XMLSchema-Instance http://www.3gov.org/2007/XMLSchema-Instance http://www.iugonet.org/data/schema/iugonet.xsd">
  <Version>1.0.0</Version>
  <NumericalData>
    <ResourceID>space://IUGONET/NumericalData/STEL/SuperDARN/HO/KH Fradar/td_hok_common_ergscdf</ResourceID>
    <ResourceHeader>
      <ResourceName>SuperDARN Hokkaido HF radar, common mode data distributed by ERG-00</ResourceName>
      <Description>Common mode data generated by SuperDARN Hokkaido HF radar. Data files are distributed in the CDF format through ERG-00</Description>
      <Contact>
        <PersonID>space://IUGONET/Person/Wakamu.Mitsuharu</PersonID>
        <Role>Principal Investigator</Role>
      </Contact>
    </ResourceHeader>
    <AccessInformation>
      <RepositoryID>
        <space://IUGONET/Reposit by STEL/ERG-00</RepositoryID>
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      <AccessRights>Open</AccessRights>
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      </AccessURL>
      <Format>CDF</Format>
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    <MeasurementType>Dopplergram</MeasurementType>
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        <StartDate>2005-12-02T00:00:00</StartDate>
        <RelativeStopDate>P7D</RelativeStopDate>
      </TimeSpan>
      <Calence>P30</Calence>
      <Exposure>P30</Exposure>
    </TemporalDescription>
    <ObservedRegion>
      Earth, Near Surface, Atmosphere F Region
    </ObservedRegion>
    <SpatialCoverage>
      <CoordinateSystem>
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        <CoordinateSystemName>GEO</CoordinateSystemName>
        <CoordinateSystem>
          <NorthernmostLatitude>84.0</NorthernmostLatitude>
          <SouthernmostLatitude>30.0</SouthernmostLatitude>
          <EasternmostLongitude>130.0</EasternmostLongitude>
          <WesternmostLongitude>130.0</WesternmostLongitude>
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        </CoordinateSystem>
      </SpatialCoverage>
    <Parameter>
      <Name>Max range gate 0</Name>
      <Description>Maximum range gate number for 75 range gate mode, namely 75</Description>
      <Support>
        <SupportQuantity>Temporal</SupportQuantity>
      </Support>
    </Parameter>
  </NumericalData>
  ...
```

Xmlで作成して  
各機関から収集

## Resource ID

全研究リソースに対してuniqueに割り振られるURI形式のID  
space://IUGONET/NumericalData/STEL/SuperDARN/HO/KHFradar/sd\_hok\_common\_ergscdf

## Resource Header部

リソースの名前、説明、発行日時、コンタクト情報など

## Access Information部

実データDBの場所、データファイルのフォーマット、アクセス権限などの情報

## Instrument ID, Measurement Type

このデータを取得した観測器に関する情報。観測器自体のメタデータへリンクしている

## Temporal Description部

データが存在する時間範囲、またデータの時間分解能に関する情報

## Observed Region

観測領域に関する情報。この場合は地球電離圏のF層

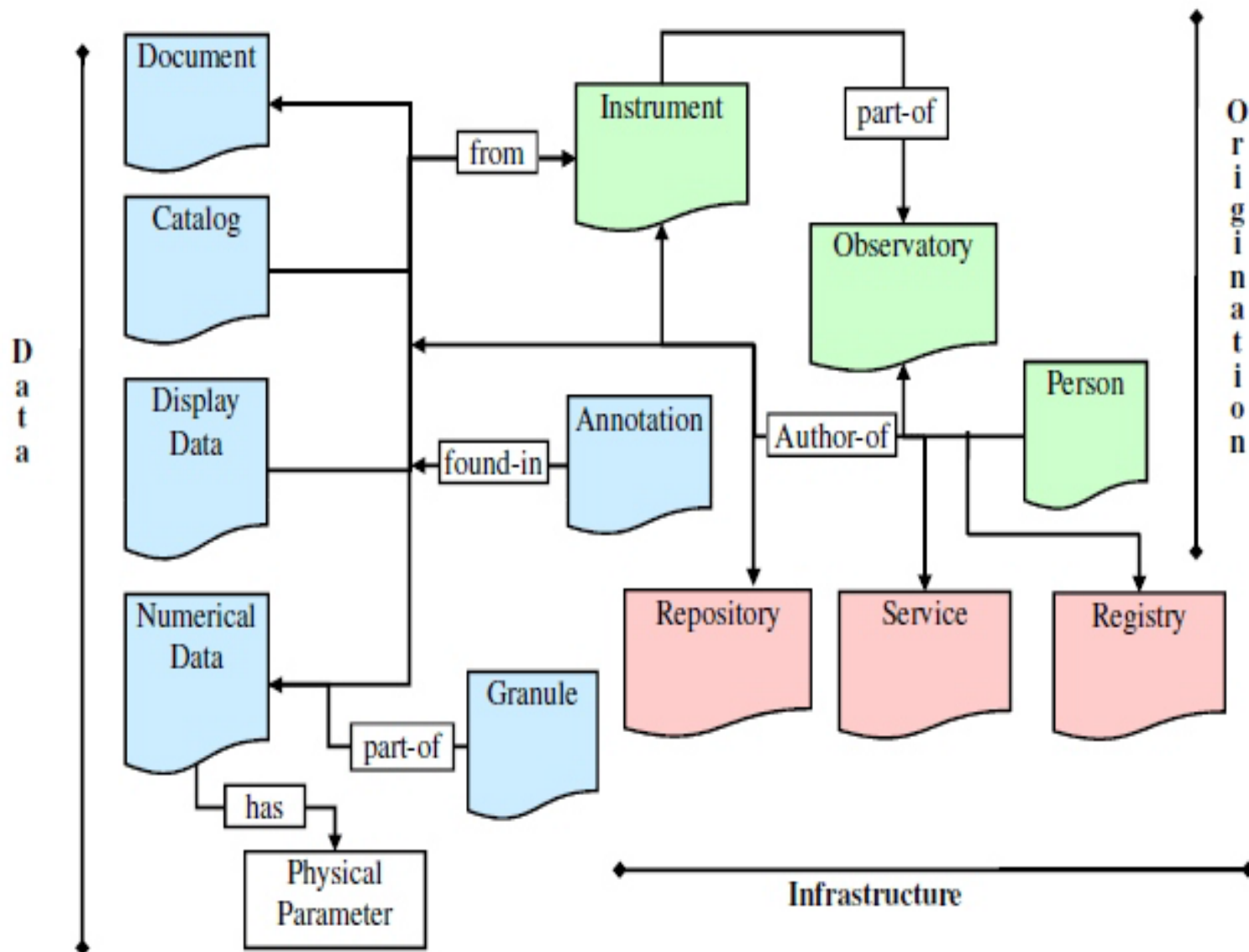
## Spatial Coverage部

観測領域の範囲の緯度・経度・高度等の情報(時刻+)観測範囲での検索に利用

## Parameter部

データとして入っているパラメータに関する情報。パラメータ名、属性、変数配列の構造、など

# SPACE メタデータ間の関連 (オントロジー)

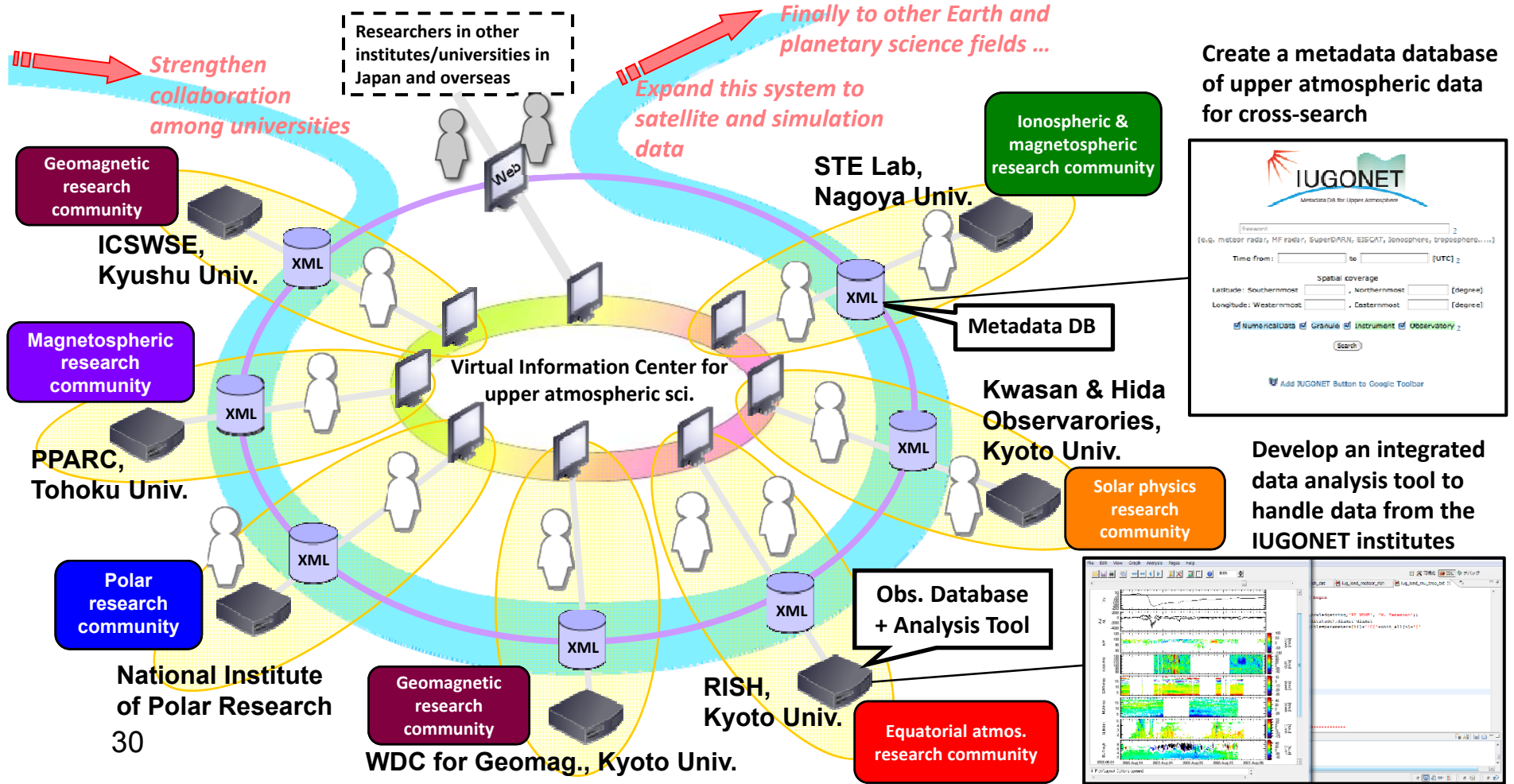


**PROBLEM:** Various kind, huge amount of data spread over institutes and universities

Automatic

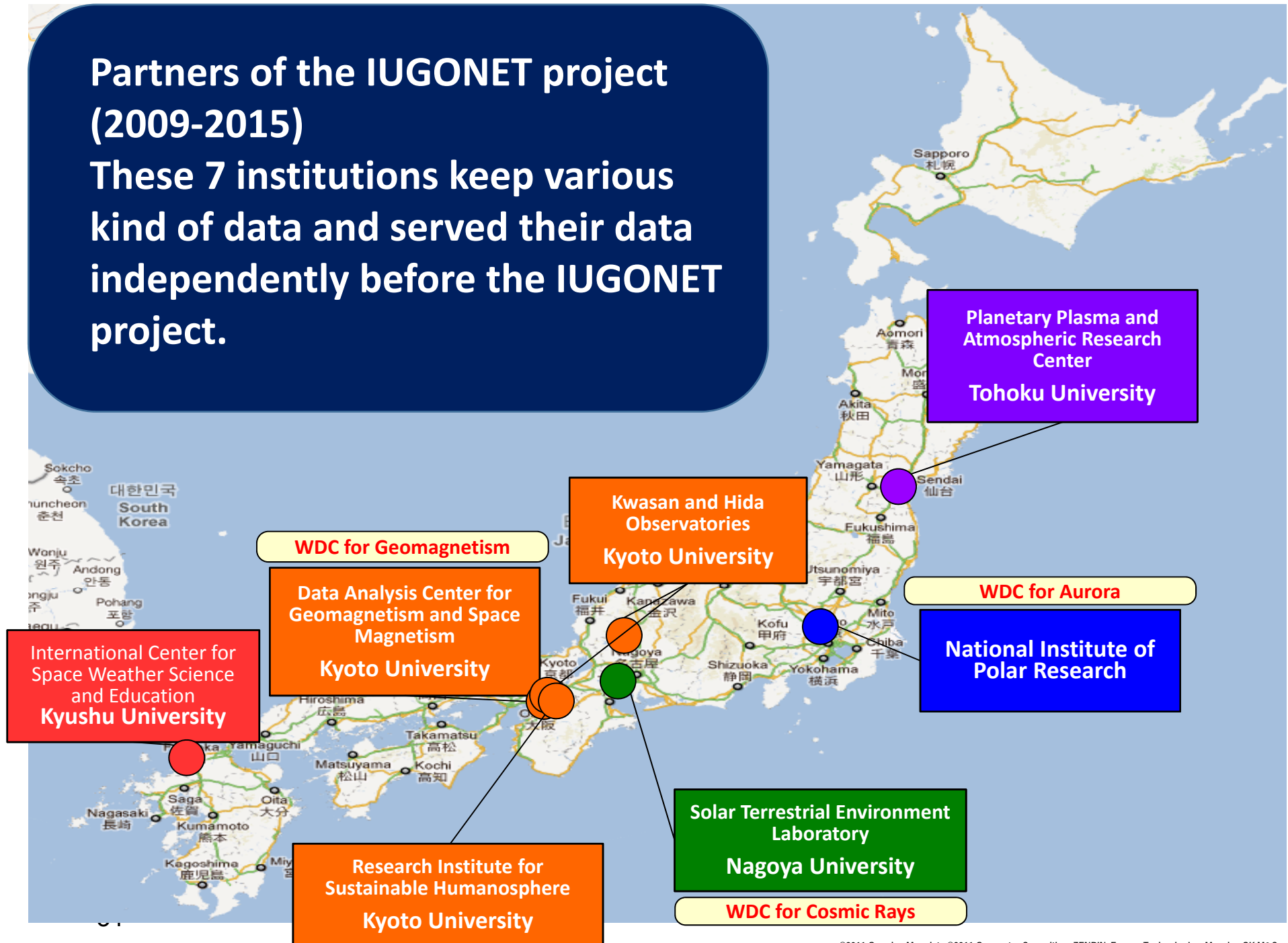
**SOLUTION:** Create a metadata database for cross-search of these distributed data

**Promote new types of upper atmospheric research by analysis of multi-disciplinary data**



## Partners of the IUGONET project (2009-2015)

These 7 institutions keep various kind of data and served their data independently before the IUGONET project.



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

