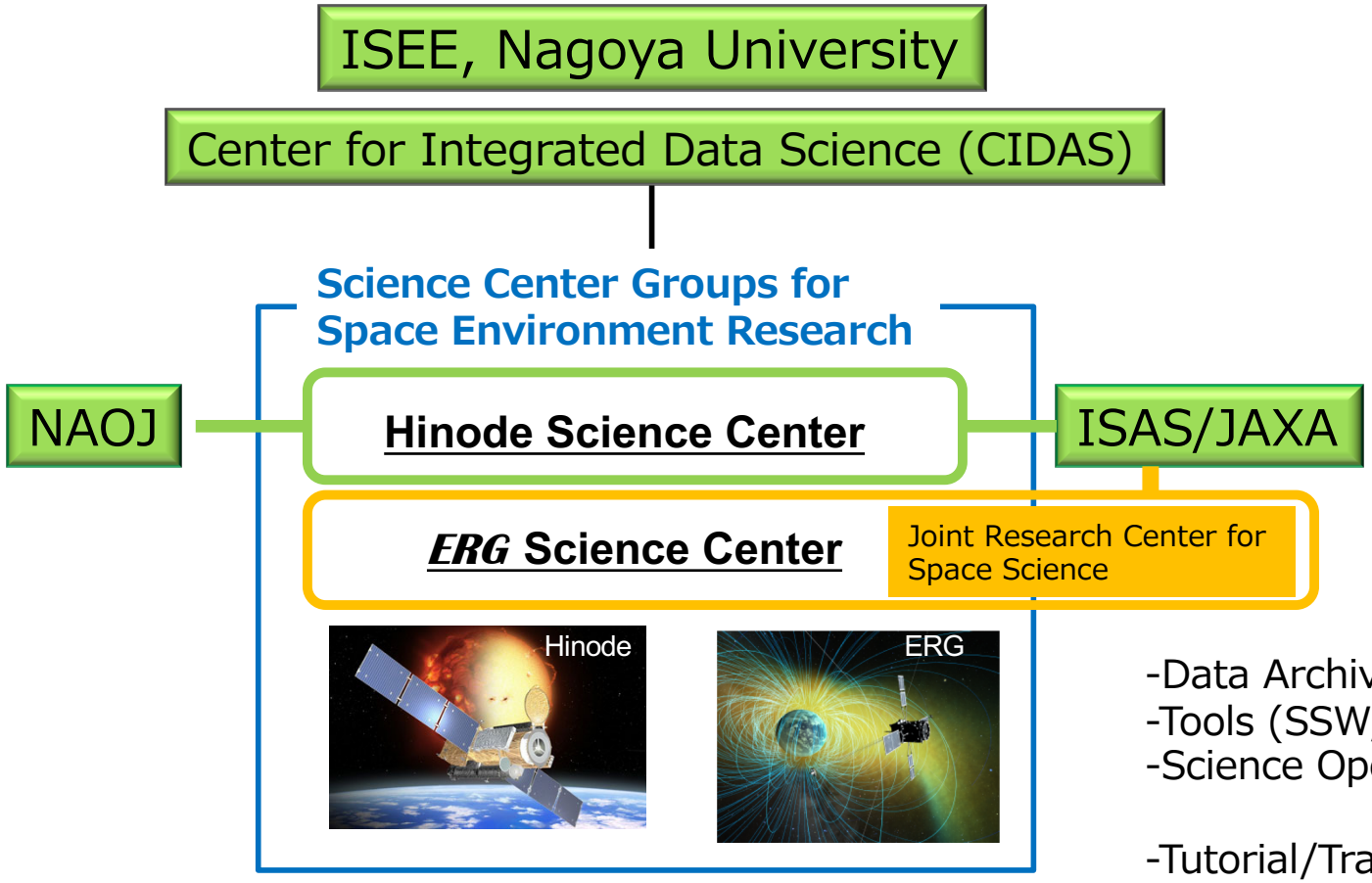
Japanese Heliophysics Satellite Project
Data Management Activity

- Solar Physics:　Hinode (Solar-B) -
- Geospace Physics: Arase (ERG)　-

ISEE/Nagoya University
Yoshi Miyoshi (Arase/ERG Project Scientist, ERG-SC Mgr.)
Shinsuke Imada (Solar-C_EUVST Project Scientist)
Tomo Hori (ERG Science Center/Deputy Mgr.)

Collaborations between ISAS/JAXA and ISEE, Nagoya University

- Hinode Science Center
- ERG Science Center



-Data Archive w/ Standard Format
-Tools (SSW/SPEDAS)
-Science Operation Plan

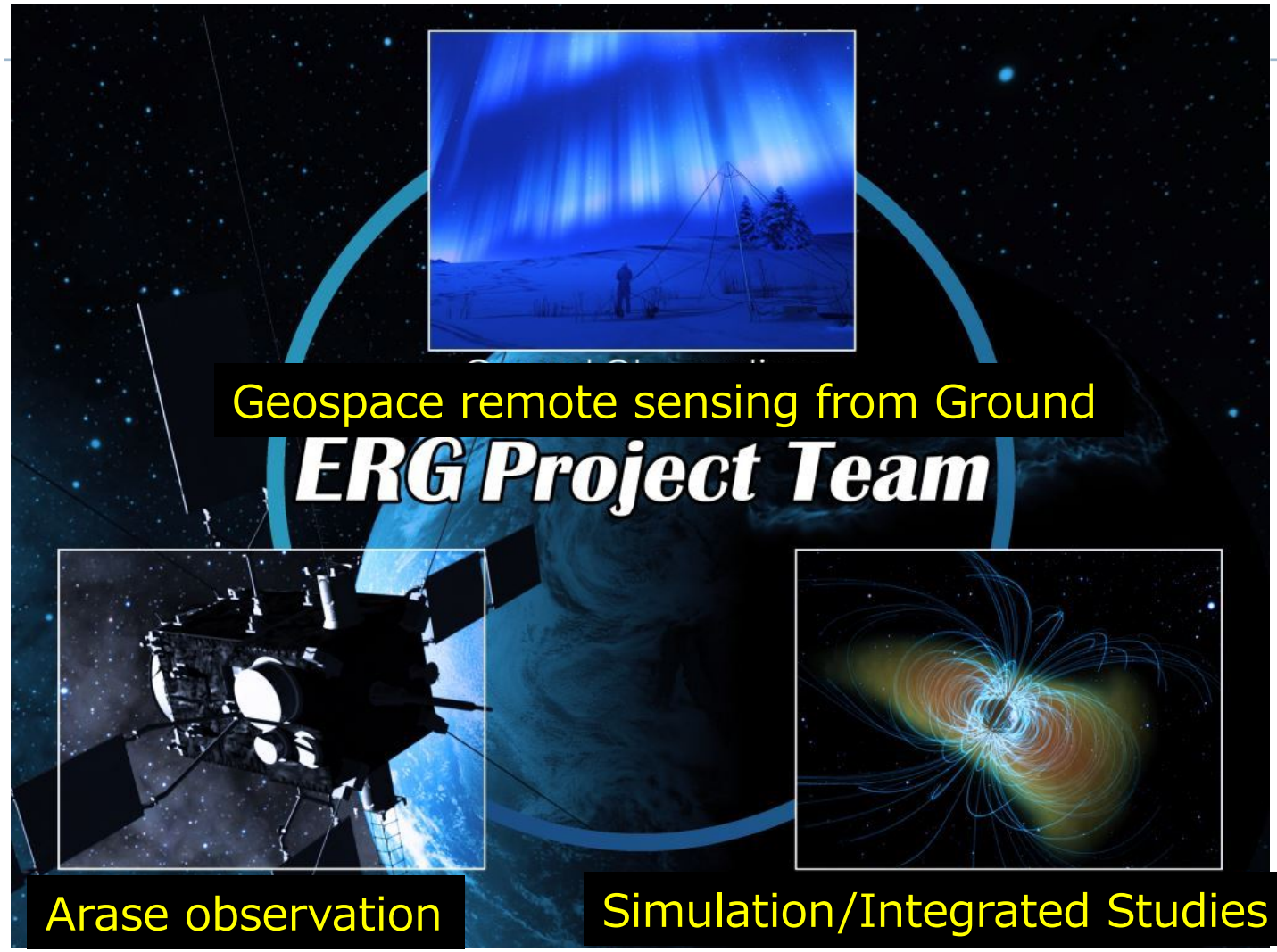
-Tutorial/Training Course

Inter-university/institutions
cooperation

Data
Integrated data analysis tool

Science Community

ERG /Arase *Project*

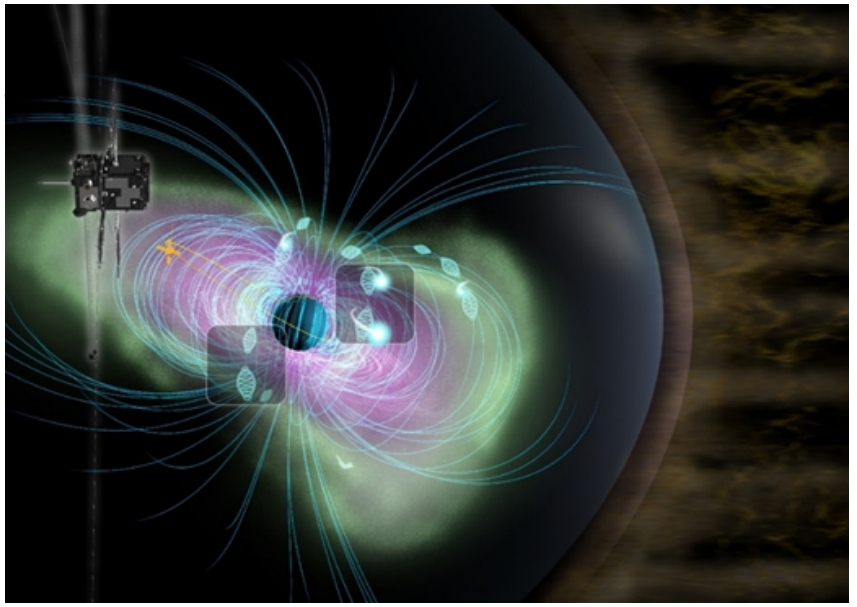


More than 100 researchers in Japan and Taiwan joined this project.

Please see Miyoshi+[2018, EPS] for overview of the project.

Geospace Exploration Satellite: Arase

- **Launch:** Dec. 20, 2016
- **Extended Mission:** – March 2022
- **Apogee :** 32246 km
- **Perigee :** 400 km
- **Inclination Angle :** 31.427deg
- **Spin Periods :** 8 sec
- **Orbital Periods:** 563.85 min



■ Electrons:

LEPe (19 eV – 20 keV) : 3D
MEPe (8 keV – 80 keV) : 3D
HEP (70 keV – 2 MeV) : 3D
XEP (400 keV – 20 MeV) : 2D

■ Ions w/ mass discriminations

LEPi (10 eV/q – 25 keV/q): 3D & TOF
MEPi (8 keVq - 180 keV/q): 3D & TOF

■ Electric Fields:

PWE: EFD (DC – 256 Hz): waveform/spectrum
potential
PWE: OFA/WFC (10 Hz – 32 kHz):
spectrum/waveform
PWE: HFA (20 kHz – 10 MHz): spectrum

■ Magnetic Fields:

MGF: (DC-128 Hz): waveform
PWE: OFA/WFC (10 Hz – 32 kHz):
spectrum/waveform

Development of science data archive and data analysis tools by ERG-Science Center (ERG-SC)

T. Hori

[Miyoshi+, EPS, 10.1186/s40623-018-0867-8, 2018]

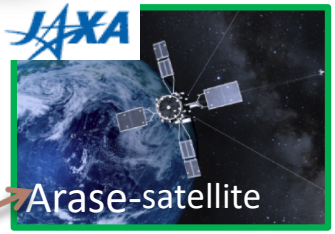
ERG-Science Center (ERG-SC)

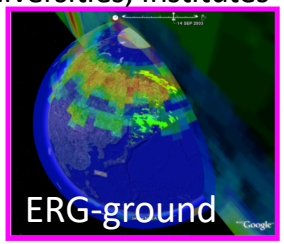
Google ERG Science Center

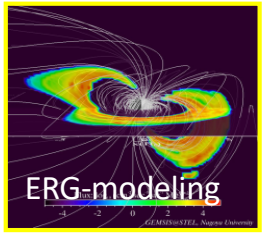
ERG project data

Universities, Institutes

Universities, Institutes

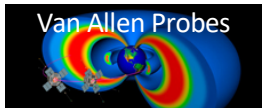






Planning of satellite operation and campaign observations

collaboration



ISEE **ERG – Science Center** JAXA

operated by ISEE/Nagoya Univ. and ISAS/JAXA

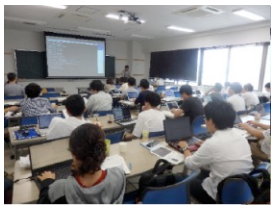
collaboration

THEMIS

IUGONET

science data archive | integ. data analysis tools | observation planning

Data analysis workshop/training



Researcher Student

Researcher

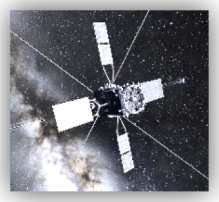
Student

Student Researcher

ERG-SC serves as the center of data archive, science coorindation, and scientific research

ERG project data

- Various time series data from ERG(Arase) satellite and multi-point ground observation data
  - Many data sets (e.g., ~60 data sets from Arase satellite)
    - Data format, availability, etc. differs for different data sets.
    - Typically 10 MB–100 GB for one day, could be more.

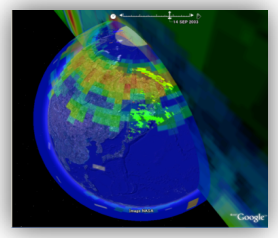


Arase satellite

~1 GB / day from 9 onboard instruments

Total file size for 2 years and half

~3 TB

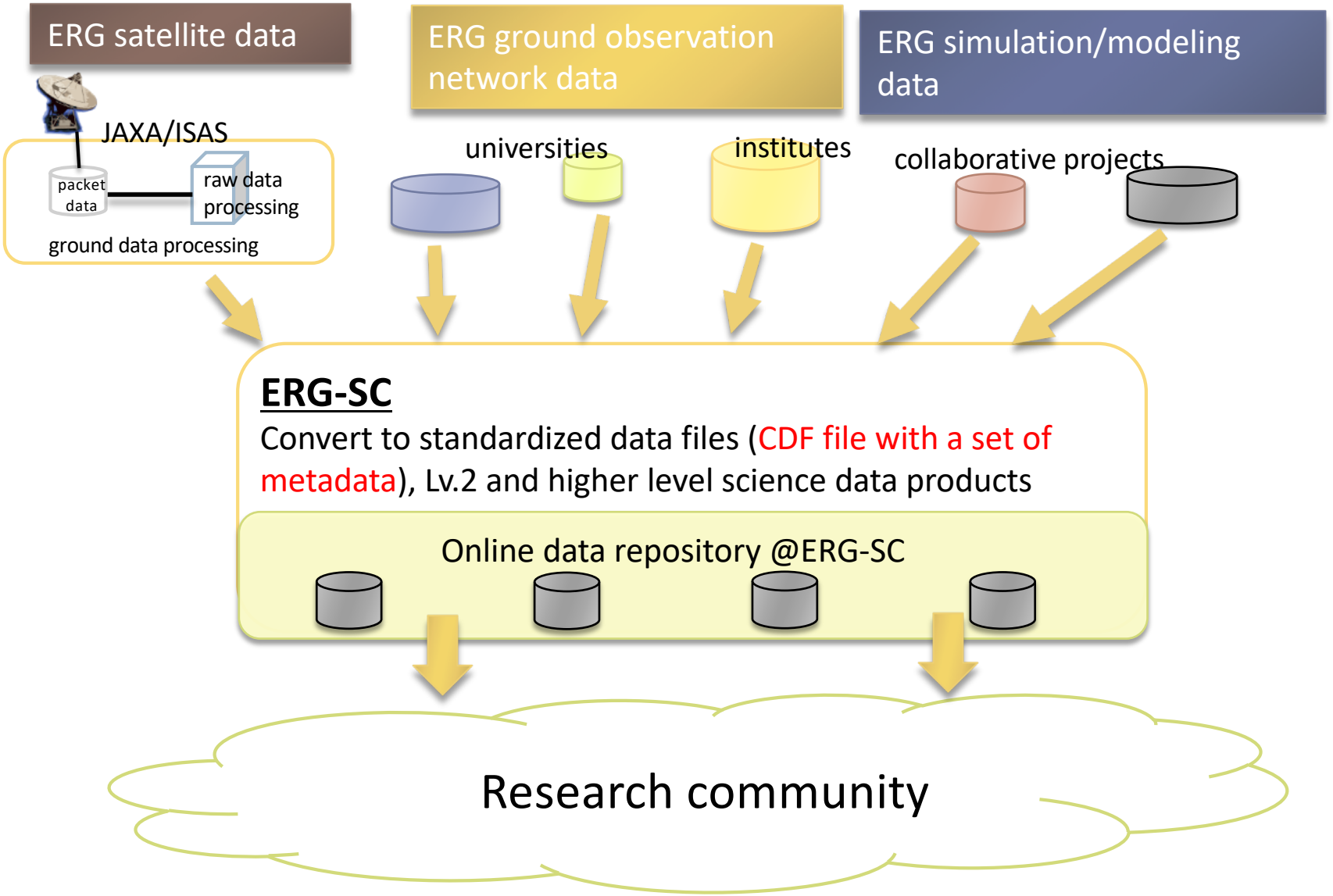


Ground data

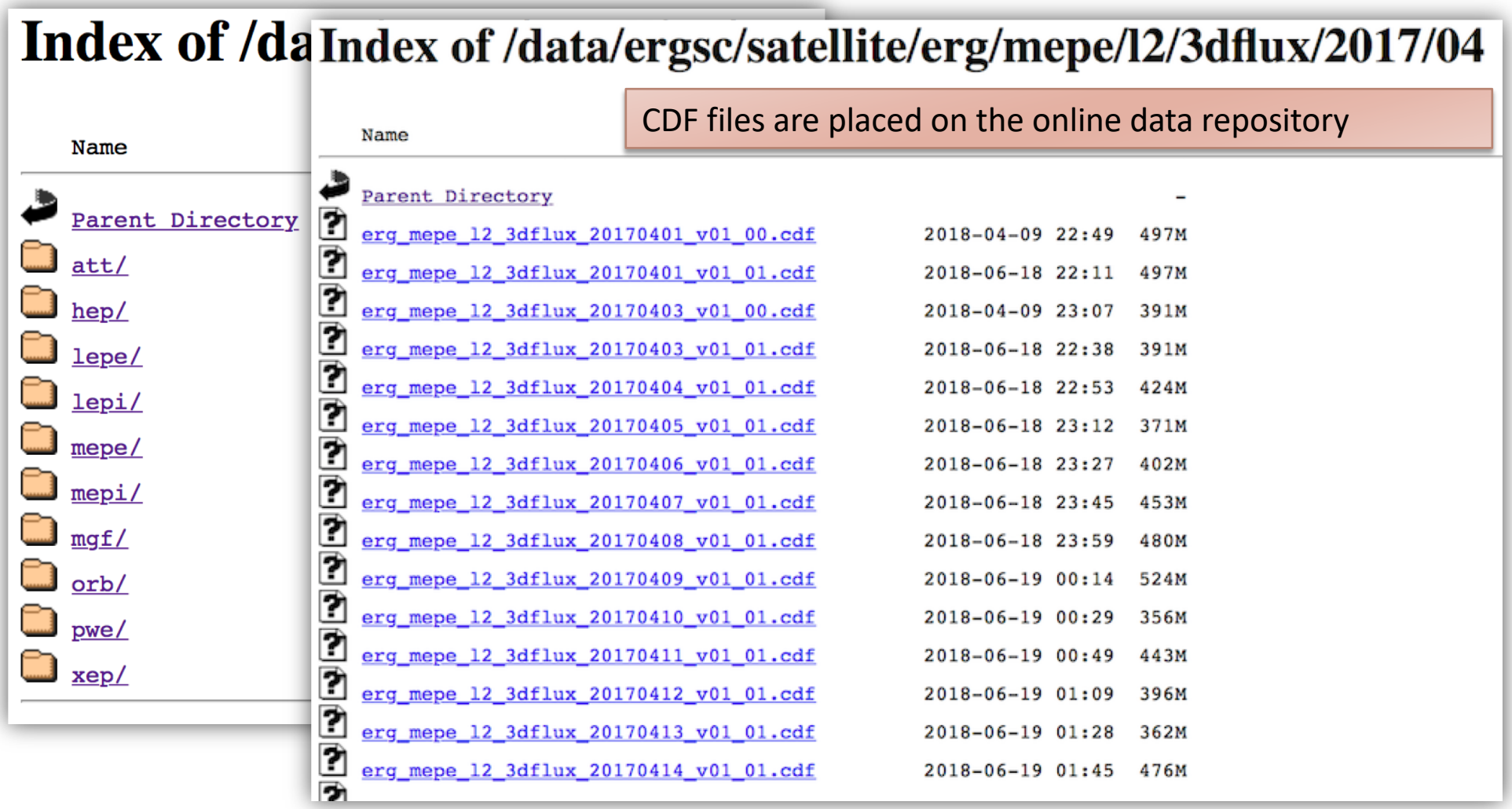
~1 MB to 1 TB / day, more data with increasing obs. site

~10 TB
+ high-speed aurora camera
~600 TB or more?

Integrated science data archive developed by ERG-SC



Integrated science data archive developed by ERG-SC



Index of /da

Name

Parent Directory
att/
hep/
lepe/
lepi/
mepe/
mepi/
mgf/
orb/
pwe/
xep/

Index of /data/ergsc/satellite/erg/mepe/l2/3dflux/2017/04

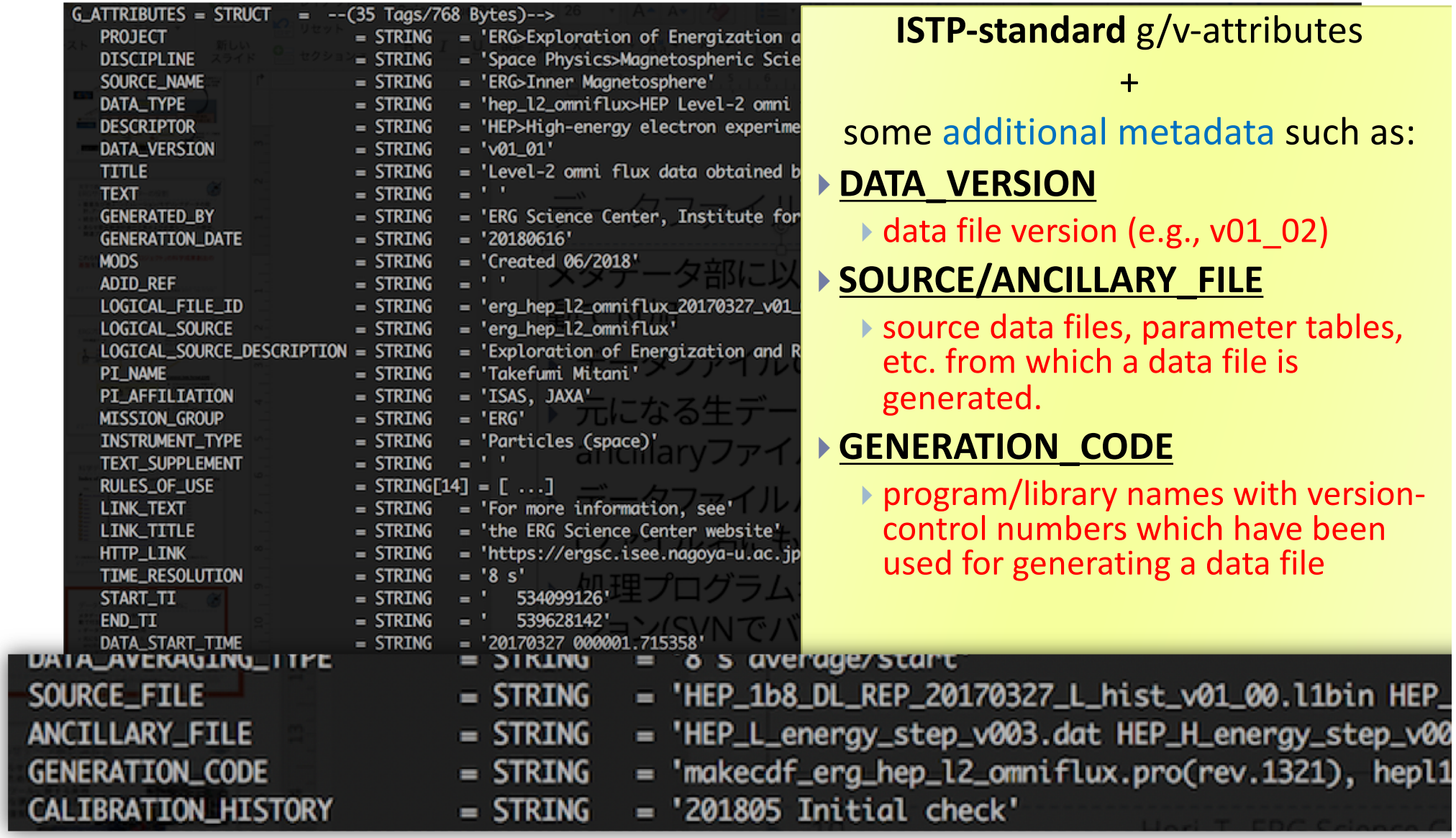
CDF files are placed on the online data repository

Name			
Parent Directory			-
erg_mepe_l2_3dflux_20170401_v01_00.cdf	2018-04-09	22:49	497M
erg_mepe_l2_3dflux_20170401_v01_01.cdf	2018-06-18	22:11	497M
erg_mepe_l2_3dflux_20170403_v01_00.cdf	2018-04-09	23:07	391M
erg_mepe_l2_3dflux_20170403_v01_01.cdf	2018-06-18	22:38	391M
erg_mepe_l2_3dflux_20170404_v01_01.cdf	2018-06-18	22:53	424M
erg_mepe_l2_3dflux_20170405_v01_01.cdf	2018-06-18	23:12	371M
erg_mepe_l2_3dflux_20170406_v01_01.cdf	2018-06-18	23:27	402M
erg_mepe_l2_3dflux_20170407_v01_01.cdf	2018-06-18	23:45	453M
erg_mepe_l2_3dflux_20170408_v01_01.cdf	2018-06-18	23:59	480M
erg_mepe_l2_3dflux_20170409_v01_01.cdf	2018-06-19	00:14	524M
erg_mepe_l2_3dflux_20170410_v01_01.cdf	2018-06-19	00:29	356M
erg_mepe_l2_3dflux_20170411_v01_01.cdf	2018-06-19	00:49	443M
erg_mepe_l2_3dflux_20170412_v01_01.cdf	2018-06-19	01:09	396M
erg_mepe_l2_3dflux_20170413_v01_01.cdf	2018-06-19	01:28	362M
erg_mepe_l2_3dflux_20170414_v01_01.cdf	2018-06-19	01:45	476M

Normally Level-2 (calibrated, in physical unit) and higher level data are open to the public with a 1-year latency

[Hori+, JSSIJ, 2015]
(https://repository.exst.jaxa.jp/dspace/handle/a-is/326251?locale=en)

The metadata structure of the standardized data files



ISTP-standard g/v-attributes

+

some additional metadata such as:

- **DATA_VERSION**
  - data file version (e.g., v01_02)
- **SOURCE/ANCILLARY_FILE**
  - source data files, parameter tables, etc. from which a data file is generated.
- **GENERATION_CODE**
  - program/library names with version-control numbers which have been used for generating a data file

Space Physics Environment Data Analysis Software (SPEDAS)

[Angelopoulos+, SSR, 10.1007/s11214-018-0576-4, 2019]

Past, ongoing satellites

Repository

CDF

THEMIS

CDF

Van Allen Probe

CDF

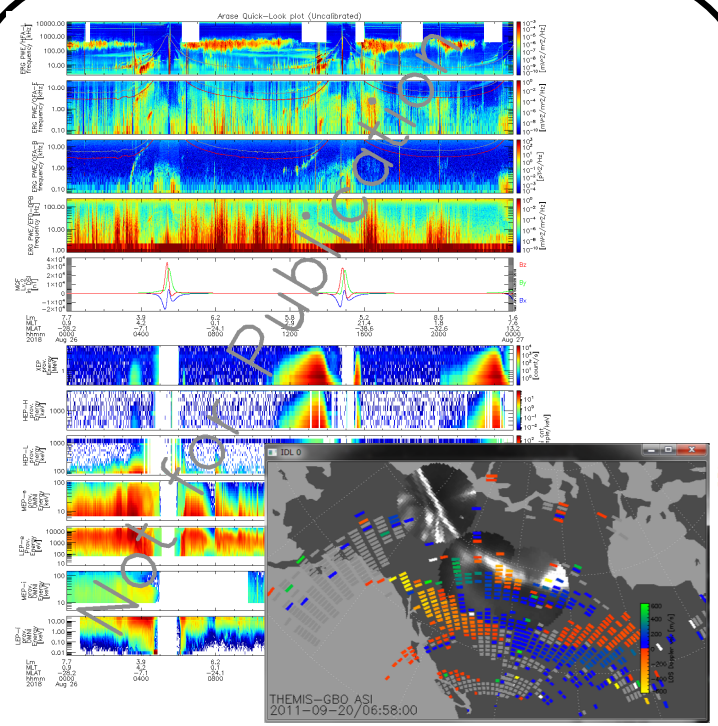
MMS

CDF

IUGONET

Ascii

CDF



- API for data sets of a project is prepared as a plug-in.
- Users can download and load data to plot multiple data seamlessly.

ERG

Exploration of energization and Radiation in Geospace

CDF

Arase satellite data

CDF

ERG ground data

CDF? HDF?

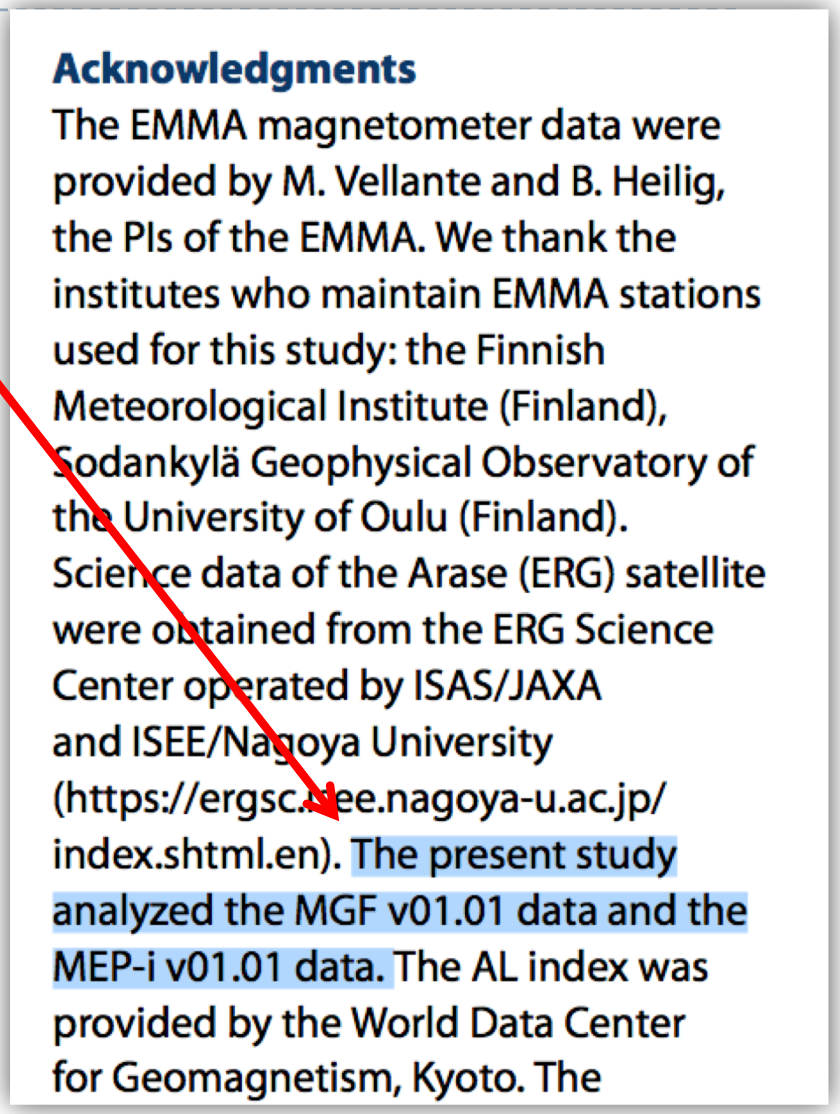
Simulation / modeling data

ERG-SC developed the API and online repository for ERG project data as the ERG-SC plugin, contributing to international collaboration on data/tool standardization.

Collaborations with THEMIS/SPEDAS(TDAS) since 2009.

Traceability from an article to science data

- ERG project requires all data users to write the version numbers of used data in Acknowledgments section, allowing data to be truly "**reusable**".
  - Although data version continues to be incremented as new calibrations / correction methods are applied, anyone can **reproduce the same analysis as the authors did** with exactly the same data files.
  - Information on source data and data processing programs, which are stored in ERG-SC CDF files, guarantees **traceability** up to the level of raw data and its processing code.



Acknowledgments

The EMMA magnetometer data were provided by M. Vellante and B. Heilig, the PIs of the EMMA. We thank the institutes who maintain EMMA stations used for this study: the Finnish Meteorological Institute (Finland), Sodankylä Geophysical Observatory of the University of Oulu (Finland). Science data of the Arase (ERG) satellite were obtained from the ERG Science Center operated by ISAS/JAXA and ISEE/Nagoya University (https://ergsc.isee.nagoya-u.ac.jp/index.shtml.en). The present study analyzed the MGF v01.01 data and the MEP-i v01.01 data. The AL index was provided by the World Data Center for Geomagnetism, Kyoto. The

[Yamamoto+, GRL, 2018]