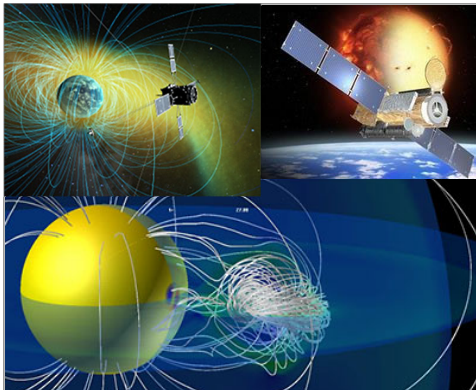# Center for Integrated Data Science (CIDAS)

- ■ Hinode Science Center
- ■ ERG Science Center
- ■ Research and development of advanced simulations (SUSANOO, CReSS, Monte Carlo simulations for high-precision age calculations, etc.)
- ■ Construction of various databases (IUGONET, WDS-CR, etc.)
- ■ Operation of CIDAS supercomputer system
- ■ Membership activity of HPCI consortium

The Center for Integrated Data Science (CIDAS) aimed to construct infrastructure and conduct research and development to realize a cutting-edge scientific study of the space–Earth environmental system through integrated analyses using various observational data and advanced computer simulations. CIDAS operates many projects in cooperation with the research divisions and centers of ISEE, as well as other universities and institutes.

Science centers for space missions: Hinode and ERG

The Hinode Science Center is operated as a joint project with NAOJ and developed the database and analytical environment for the data provided by the Japanese solar observation satellite Hinode. At the same time, it plays an important role in considering research topics of oncoming solar missions such as Solar-C EUVST. In addition, ERG Science Center operates as a joint research center in cooperation with the Institute of Space and Astronautical Science/Japan Aerospace Exploration Agency (ISAS/JAXA), which releases the data files from ERG (Arase) and ground-based observations. The ERG Science Center also develops the data analysis software. The CIDAS computer system has been used for the data analysis environment for Hinode and ERG projects.

Cooperative research program for database construction and supercomputing

CIDAS produces various databases for space–Earth environmental research and provides supercomputing facilities in collaboration with the Information Technology Center (ITC) of Nagoya University and other universities and institutes. CIDAS has also joined the inter-university network project (Inter-university Upper atmosphere Global Observation NETwork: IUGONET) with Tohoku University, NIPR, Kyoto University, Kyushu University, and Nagoya University to develop a metadata server and data analysis software. CIDAS is in charge of activities in ISEE as a member of the High-Performance Computing Infrastructure Consortium (HPCI) in Japan.

Research and development of advanced simulations

CIDAS plays a leading role in research and development of the following advanced computer simulation models: Space Weather Forecast Usable System Anchored by Numerical Operations and Observations (SUSANOO), the Cloud Resolving Storm Simulator (CReSS), and Monte Carlo simulations for accurate Th-U-Pb dating. The CReSS model is designed for all types of parallel computers to simulate a detailed structure of clouds and storms. CReSS is free to use for scientific community. It has been used for meteorological research and real-time weather forecast experiments, for example, simulation experiments of tropical cyclones, heavy rainfall events, snow clouds, tornados, and downscaling experiments of future tropical cyclones.

Main Activities in FY2019

Development of a data analysis system for the ERG (Arase) project

Scientific data from the ERG (Arase) satellite, ground-network observations, and modeling/simulations are archived at the ERG Science Center, which is operated by ISAS/JAXA and ISEE/Nagoya University. The format of these data files is CDF, and includes the metadata of each file. This is a de facto format in the solar–terrestrial physics community. The Space Physics Environment Data Analysis System (SPEDAS), a commonly used software in the solar–terrestrial physics community, can easily read and manipulate CDF files. The ERG Science Center has developed CDF files and SPEDAS plug-in software for the ERG project. We also join the International Heliosphere Data Environment Alliance (IHDEA) to discuss the common data formats in the international framework. The ERG Science Center has organized the training sessions for SPEDAS in Japan and Taiwan, providing important opportunities to learn to use SPEDAS and the ERG data. The ERG Science Center is also developing a data analysis environment in the CIDAS system. Users can access the CIDAS system via the Internet and analyze the ERG project data using SPEDAS.

Coronal mass ejection arrival time forecasting system using IPS observations

MEs cause disturbances in the environment around the Earth. CIDAS has installed a dedicated computing system for CME forecasting and developed a CME forecasting system under a collaborative study with the ISEE Division for Heliospheric Research and NICT. In this system, CME propagation is calculated using a global MHD simulation, SUSANOO-CME. The IPS response is estimated by the 3-dimensional density distribution of the inner heliosphere derived from the MHD simulation. The simulated IPS response is then compared with actual IPS observations performed by the Division for Heliospheric Research, providing a forecast with better accuracy than before. This system will be included in the real-time forecasting system of NICT.

Activity of Inter-university Global Upper atmosphere Observation NETwork (IUGONET)

We have promoted the use and application of upper atmospheric observation data, through database and analysis software in collaboration with other institutions (e.g., the Research Organization of Information and Systems (ROIS)), and developed the foundation for a universal infrastructure for disclosing and citing data promptly. We also abstracted a database design and have now provided these developments to each institute and committee to promote data activity. We have held several international data analysis workshops in collaboration with several international programs, including VarSITI/PRESTO and World Data System (WDS) affiliated with the International Science Council (ISC), and supported the construction of infrastructure for disclosing data and data integrity to them.

Operation of the CIDAS supercomputer system

The CIDAS supercomputer system for integrated data analysis is under operation since FY2016. The system consists of 20 computer nodes, with each node having two Intel Xeon E5-2660 v3 CPUs and 256 GB memory. In FY2019, 170 researchers/students were registered as users of the CIDAS supercomputer system and data analyses related to the Hinode Science Center and ERG/Arase Science Center, as well as computer simulation studies, were conducted.

Development of the CReSS model

The CReSS model has been developed and improved for physical processes. It is available for scientific research from CIDAS. The CReSS model is used for simulation experiments and daily weather forecasts. The simulated daily forecast data are openly available from the website of the meteorological laboratory. CIDAS also plans to make the simulation output data from the CReSS model available.