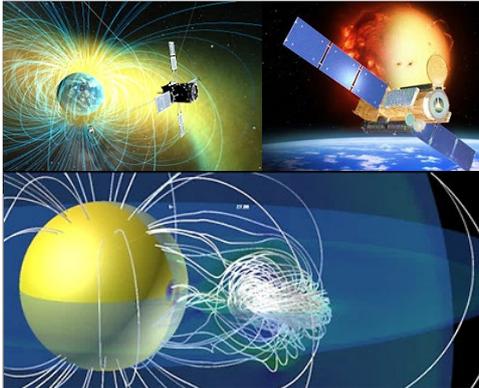


## Center for Integrated Data Science (CIDAS)



- Center for Heliospheric Science
- Research and development of advanced simulations (SUSANOO, CReSS, Monte Carlo simulations for high-precision age calculations)
- Construction of various databases (IUGONET, WDS-CR)
- 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 perform 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 ISEE research divisions and centers and other universities and institutes.

### Center for Heliospheric Science: Arase, Mio, Hinode, SOLAR- C

The Center for Heliospheric Science (CHS), which is responsible for the development and release of integrated analysis tools and data files from Arase, Mio, Hinode, and SOLAR-C, including ground-based observations and simulations, is operated by ISEE, Nagoya University, ISAS/JAXA, and NAOJ. For this purpose, the CHS operates an Integrated Data Science Computer System (CIDAS system) that provides an analysis environment for researchers.

### 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 of Nagoya University and other universities and institutes. CIDAS mints DOIs for ISEE research data (DOI prefix: 10.34515) to ensure permanent accessibility and promote the reusability of the data. 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 databases server and data analysis software. CIDAS is responsible for 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 researching and developing the following advanced computer simulation models: Space Weather Forecast Usable System Anchored by Numerical Operations and Observations (SUSANOO), Cloud Resolving Storm Simulator (CReSS), and Monte Carlo simulations for accurate Th-U-Pb dating. The CReSS model was designed for all types of parallel computers to simulate the detailed structure of clouds and storms. CReSS is free to use for the scientific community. It has been used for meteorological research and real-time weather forecast experiments, such as simulation experiments of tropical cyclones, heavy rainfall events, snow clouds, tornados, and downscaling experiments of future tropical cyclones.

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## Main Activities in FY2022

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### Development of a data analysis system for the ERG (Arase) and Mio (BepiColombo/MMO) project

Scientific data from the ERG (Arase) satellite, ground-network observations, and modeling/simulations were archived at the Center for Heliospheric Science (CHS), 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 CHS has developed CDF files and SPEDAS plug-in software for the ERG project. We also joined the International Heliosphere Data Environment Alliance to discuss common data formats in the international framework. The CHS has organized training sessions for SPEDAS in Japan and Taiwan, providing important opportunities to learn to use SPEDAS and ERG data. The CHS is also developing a data analysis environment for the CIDAS system. Users can access the CIDAS system via the internet and analyze ERG project data using SPEDAS (<https://ergsc.isee.nagoya-u.ac.jp/research/index.shtml.en>). The CHS is also working for development of the Mercury magnetospheric orbiter Mio (MMO) data files and related tools based on the heritage of the ERG project.

### Synthesis of infrared Stokes spectra in an evolving chromospheric jet

Chromospheric jets are believed to play an imperative role in energy and mass transfer within the solar chromosphere, although their driving mechanisms remain unknown. Accurate measurements of magnetic fields are essential to identify these mechanisms. We performed a full Stokes synthesis in the infrared range using a realistic radiative magnetohydrodynamic simulation to generate a chromospheric jet and predict spectropolarimetric observations from the Sunrise Chromospheric Infrared Spectropolarimeter (SCIP) aboard the SUNRISE III balloon telescope. The jet's launch was initiated by the collision between the transition region and upflow, driven by the ascending motion of the twisted magnetic field at the flux tube's envelope. This motion aligns with the upwardly propagating nonlinear Alfvénic waves. The upflow can be detected as continuous Doppler signals in the Ca ii 849.8 nm line at the envelope, where the dark line core intensity and strong linear polarization coincide. The axis of the flux tube was bright in both the Fe i 846.8 and Ca ii 849.8 nm lines, with the downflow plasma inside it. Our study's predicted structure, time evolution, and Stokes signals will enhance future spectropolarimetric observations with SUNRISE III/SCIP.

### IUGONET activity

IUGONET has been promoting the use and application of upper atmospheric observation data by providing metadata databases and analysis tools in collaboration with other institutions (e.g., the Research Organization of Information and Systems), and has been developing a universal infrastructure to disclose and cite data. In FY2022, the IUGONET metadata schema was updated, and metadata were recreated as they followed the international standard. Furthermore, we defined and implemented a mapping from the metadata schema used in the field of space physics to a general schema used for academic information distribution and converted our metadata. The converted metadata were registered in the Nagoya University institutional repository so that research data could be searched from a vast range of communities. We also developed a web-based XML file input system that allows data providers to easily create metadata to mint DOI.

### Operation of the CIDAS supercomputer system

A new computer system for integrated data analysis (CIDAS computer system) was installed on April 2021. The system consists of 16 compute nodes, each of which has two Intel Xeon Gold 6230R CPUs and 384 GiB memory. In FY2022, 140 researchers/students were registered as users of the CIDAS supercomputer system. Data analyses related to the Hinode Science Center and ERG/Arase Science Center and computer simulation studies were conducted.

### Development of the CReSS model

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