



Increasing Accessibility of the Runs-on-Request Metadata, Data, and Services at the Community Coordinated Modeling Center



ccmc.gsfc.nasa.gov

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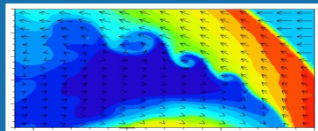
Simulating Space Weather at CCMC

Space weather models are essential to our ability to understand and predict space weather events. For over 20 years, the Community Coordinated Modeling Center (CCMC, <https://ccmc.gsfc.nasa.gov>) has been providing transformative tools and platforms for hosting space weather models and associated services, free and open to anyone interested in studying space weather. Runs-on-Request system (ROR) is one of the popular services at CCMC that permits researchers and other end-users to exercise cutting-edge hosted heliophysics and space weather models using a simple web interface, as well as collaborate on an extensive and continuously growing archive of over 28,000 model run results.

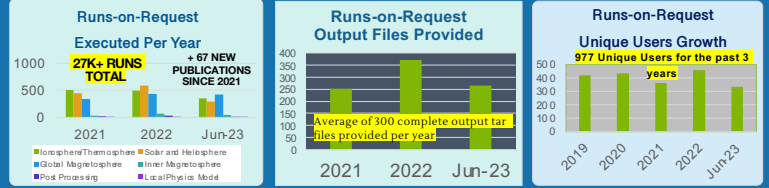
Similar to other projects at CCMC, ROR has grown as a community project that strives to be open and transparent to its users. In this poster, we discuss some of our recent efforts to further expose ROR data, metadata, and services to the end users through both custom and community-developed access protocols. We also discuss how in-house science support provided by the CCMC team plays a paramount role in making ROR data and services truly accessible by the community.

Space Science and Weather Models and Services

- CCMC hosts over 60 space weather models in multiple domains:
 - Solar
 - Heliosphere
 - Global Magnetosphere
 - Inner Magnetosphere
 - Ionosphere / Thermosphere
 - Local Physics
- CCMC's main goals:
 - Facilitate research and model development
 - Support transition of advances in research to space weather OPS
- Services freely available at CCMC for the hosted models:
 - Most models can be requested to **Run on Request** with model input parameters specified through a simple Web-based interface and results staged on a public Web-page. Interactive value-added visualization of the results is available for most models. This enables scientists who are not modelers themselves to utilize state-of-the-art models in their research.
 - A limited set of fast and simple models is available for **Instant Run**, where a model can be executed and visualized while-you-wait.
 - Certain models are run continuously to generate simulation results over long time periods testing model robustness and long-term performance, while also feeding the perpetual archive and portal of space weather information at CCMC. The results are available to researchers and decision makers in real time, through our signature interactive **tools** such as **iSWA**, **CME ScoreBoard**, and others.

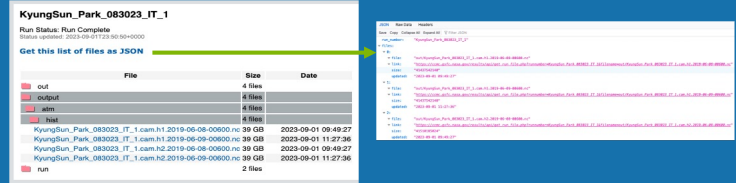


Runs-on-Request in Numbers

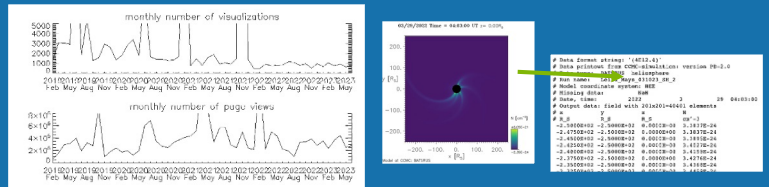


Interactive Model Data Archives in ROR and at CCMC

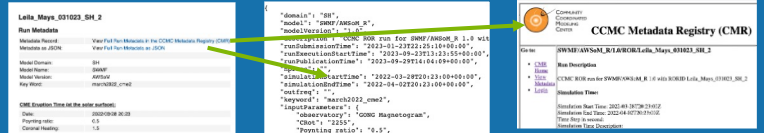
- CCMC maintains a **free and open interactive archive of model output data**, including data generated in ROR and data provided by external groups and collaborators
- Users can **search the ROR archive and download output of any run**, either as **individual files or in bulk as a single tar file**. List of links to the output files are also available as **JSON** for an easy processing in automated tools.



- Still, most models do not adhere to a single common output format, making model results largely inaccessible to the users, not familiar with a particular model
 - ROR makes the data more accessible by providing a custom interactive visualization tool. Using the tool, the users can **visualize and interact with the data in multiple dimensions**. What's more, the users can **download model output data, converted by the visualizer, in a simple and unified text format**.
 - For selected models, Runs on Request provides a **conversion service that transforms proprietary model output into a more accessible NetCDF and HDF**.



- Besides data, the users can obtain **metadata and inputs used for each of the runs in a user-readable, JSON or SPASE-like** (through CMR system) formats, making runs more transparent and reproducible by researchers.



- About **1 in 10 ROR runs** require some special handling, including input selections, debugging, custom processing etc. CCMC maintains an in-house team of heliophysics domains experts that work closely with the users of ROR. This close collaboration is what makes the data and science truly open and accessible!

CCMC Space Weather Research Portals and Forecasting Tools at CCMC

CAMEL

Comprehensive Assessment of Models and Events using Library Tools Framework

- The CAMEL framework is an integrated and flexible framework allowing users to seamlessly compare space weather and space science model outputs with observational data sets.
- The backend of the CAMEL framework takes advantage of Community Coordinated Modeling Center (CCMC) existing services.

Stereocat CME Analysis Tool

- Determine CME kinematic parameters
- Create CME height-time measurements
- Create an ensemble of CME measurements
- Save and share measurement sessions

Database Of Notifications, Knowledge, Information

- Catalog of space weather phenomena
- Knowledgebase of interpretations, simulation results, and forecasting analysis
- Online tool for dissemination of forecasts, notifications, and archiving event-focused information

SEP SCOREBOARD

CME Arrival Time SCOREBOARD

FLARE SCOREBOARD

iSWA

Integrated Space Weather Analysis System

- Web-Based Space Weather Dissemination System
- User Configurable, Interactive Products
- Web Services
- Real-Time & Historical Model + Observational Data

EEGGL Eruption Event Generator (Gibson & Low)

- Use observations defining the CME source region (location and flux rope orientation).
- Generate Gibson-Low flux rope parameters for the flux rope emergence models.

Kamodo

- Access, interpolation, and visualization of space weather models and data in Python
- Transparent unit conversion
- Interactive science discovery through Jupyter notebooks

SWPC_CAT - SWPC CME Analysis Tool

The primary tool being used by NOAA SWPC in measuring key parameters of a Coronal Mass Ejection (CME) as it emerges from the solar corona.