
National Aeronautics and Space Administration
NASA
Heliophysics
Our View of the CCMC
31 March 2014
Dave Chenette
Heliophysics Division Director

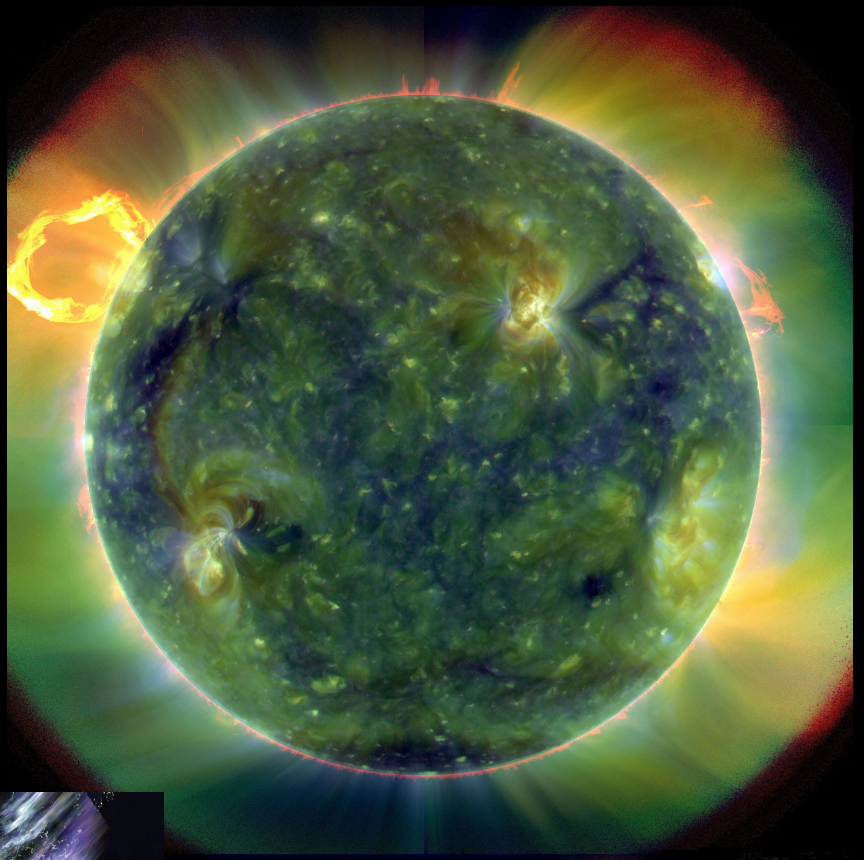
NASA Heliophysics Science Objective

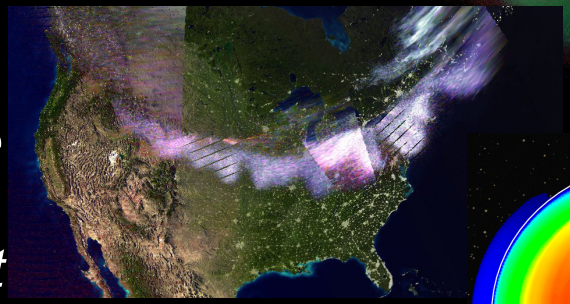
Understand the Sun and its interactions with the Earth, the Solar System, and the Galaxy.

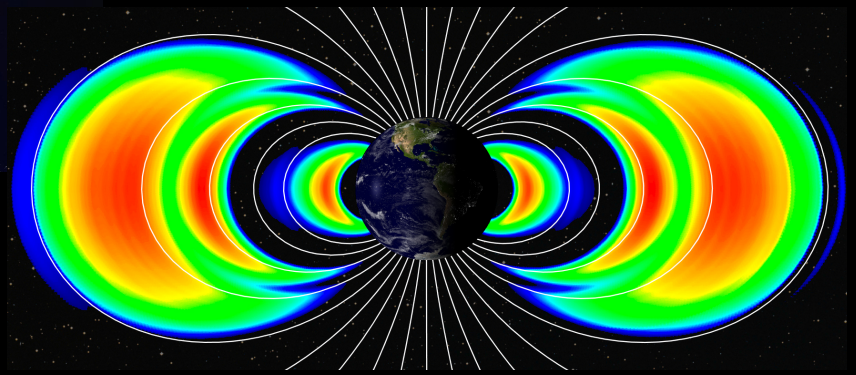
Solve the Fundamental Mysteries of Heliophysics

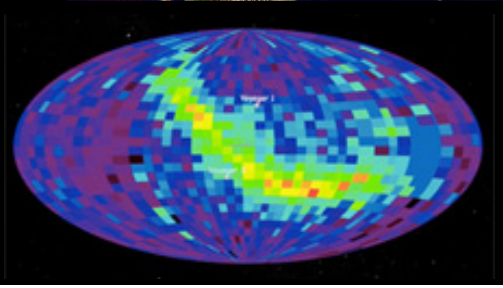
Understand the Nature of our Home in Space

Build the Knowledge to Forecast Space Weather Throughout the Heliosphere









CCMC Purpose and Charter

- **From the CCMC Concept of Operations document (2002):**

  The Community Coordinated Modeling Center was established to aid in the development of models for specifying and forecasting conditions in the space environment.

  Mission: To enable, support, and perform research for next generation space science and operational space weather models through an interagency partnership.

  Goal: Develop and execute next generation research models in support of the advancement of space sciences and development of new operational space weather capabilities.

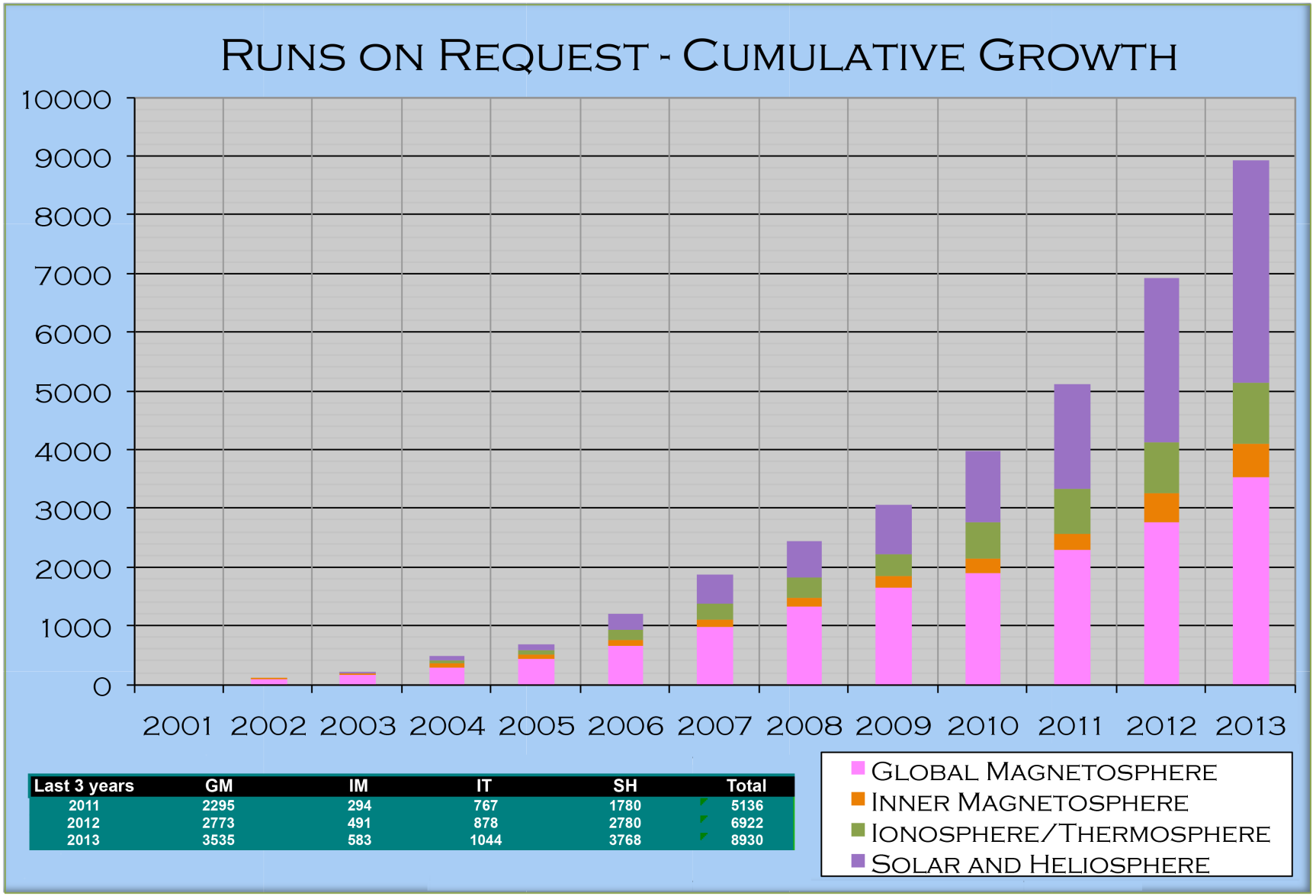
- **Also from the CCMC Concept of Operations:**

  The main success criteria for the CCMC are:

  1) The broad use of CCMC models throughout the scientific community
  2) The transition of models to operations

How well is CCMC fulfilling its mission and achieving its goal?

Metric #1: Broad Use of Models



Last 3 years	GM	IM	IT	SH	Total
2011	2295	294	767	1780	5136
2012	2773	491	878	2780	6922
2013	3535	583	1044	3768	8930

Metric #2: Transition to Operations

- **Support to NOAA's Space Weather Prediction Center**
  - Monthly tag-ups for communications, coordination, and planning
  - Supporting research on CME propagation and modeling
  - Operational geospace model validation (dB/dt & Regional-K)

- **Support to the US Air Force Weather Agency**
  - Tailored displays in ops room using Integrated Space Weather Analysis System
  - Tools for training Air Force Weather Agency forecasters
  - 1-Click Enlil & StereoCAT tools for Air Force Weather Agency operators

Metrics for both of the CCMC success criteria are strong.
Congratulations to the CCMC!

There remains much more to be done.

CCMC is a NASA Strategic Investment

- **To serve the heliophysics research community**
  - Provide efficient access to validated space physics models and model results
  - Host research models for community evaluation and validation
  - Support model developers with data and access to community users
- **To serve the operational space weather prediction community**
  - Test models for feasibility and applicability to operational requirements
  - Facilitate transition of models from research to operations
  - Support operational organizations with visualizations, model testing, & validation
- **To serve the public**
  - Communicate the importance of space weather, including educational offerings
  - Provide ready access to space weather phenomena and information

CCMC serves NASA by supporting the research and operational communities, and by providing quality information to the public.

Strategic Priorities for the CCMC

1. **Continue to pursue the documented goal of the CCMC:**

   Develop and execute next generation research models in support of the advancement of space sciences and development of new operational space weather capabilities. [expand to "Develop, support, sustain, and execute" ?]

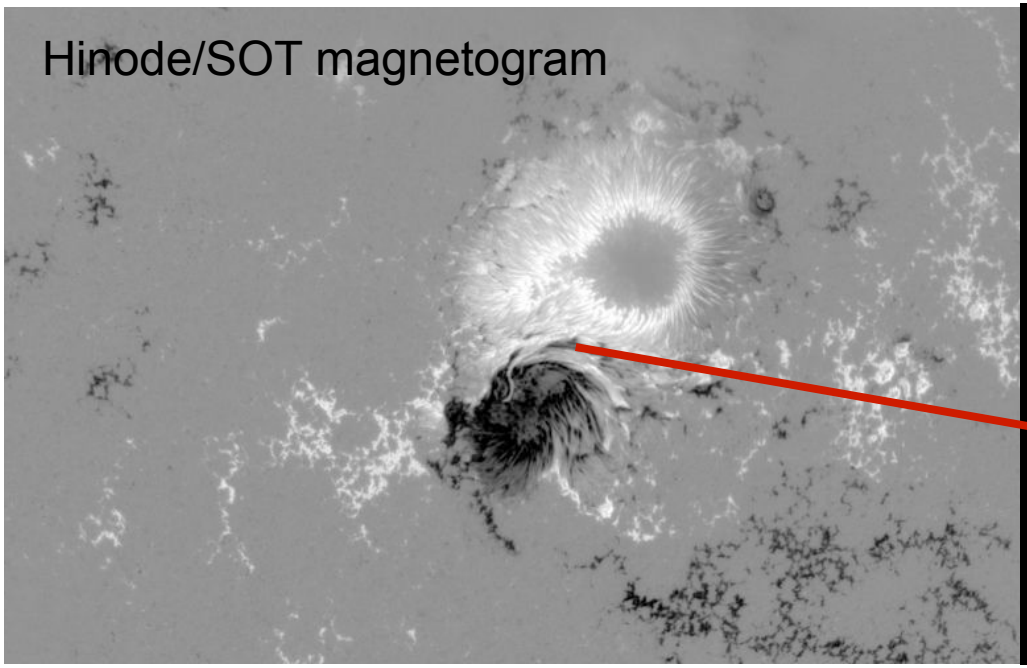
2. **Exploit and apply expertise in model integration and visualization**
   - Integrated Space Weather Analysis System, 3DView, KAMELEON

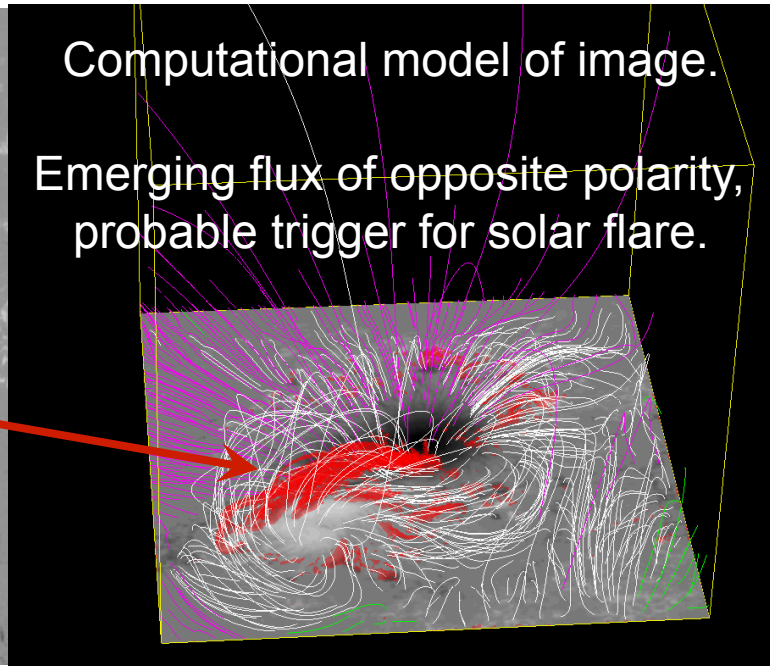
3. **Expand model validation activities, with focus on operational needs**
   - Coordinate closely with operational agencies to identify needs, plan for the future
   - Continue to maintain and expand on Space Weather Scoreboard
   - Maintain historical database of space weather observations for model validation
   - Support operational agencies with model testing and validation results
   - Lead research required to establish space weather monitoring requirements

CCMC has a unique and significant role in leading the research to better define space weather monitoring requirements.

Observational Priorities to Improve Space Weather Forecasting

- **Observing CMEs and forecasting their terrestrial impact**
  - Coronal imaging from multiple perspectives, in many ways. What works best?
  - A reliable method to determine the CME's magnetic configuration at earth
- **Forecasting of major solar flares and coronal mass ejections**
  - Detailed active region imagery of evolving magnetic structures
  - Coronal imagery from multiple perspectives for 3-D reconstructions
  - Physical modeling of the imagery to yield an understanding of the structure





Research Priorities to Improve Space Weather Forecasting

- **Better understanding of solar magnetic structures as they evolve**
  - Two different domains: near visible surface (flares), in the corona (CMEs)
  - What are the precursor signatures of instability, the key observables?
  - What measurement techniques will be most effective at revealing them?
  - How can these structures be modeled more efficiently?

- **Improved interplanetary transport models**
  - Solar wind and CME models driven by coronagraphs and coronal imagery
  - Model transport, evolution of magnetic geometry from sun to earth
  - Transport of energetic particles through the interplanetary medium

- **Improved models of the terrestrial response**
  - Multi-scale, global models of magnetosphere, ionosphere, and coupling
  - Improved models of ground-induced currents, including both the magnetic drivers, and the distributions of ground conductivity

Progress is required on many fronts to enable adequate forecasts.

Leading the research to improve space weather prediction

- **CCMC should expand its role in facilitating research to operations**
  - Coordinate with operational agencies to document and prioritize unmet needs
  - Test models and data to better define space weather monitoring requirements
  - Identify, motivate, and pursue research to improve prediction capabilities
    - What are the biggest “holes” in our space weather prediction capabilities, and why?
    - What improvements would make the biggest difference in the quality of space weather predictions?
- **CCMC should expand its role as the space weather “curator”**
  - Establish a space environment history database to facilitate model evaluation
  - Establish a repository of research results for space weather prediction
  - Evaluate and document progress in space weather prediction quality
  - Document the basis for the required improvements in space weather prediction capabilities, both models and measurement requirements
- **CCMC should stop duplicating activities of operational agencies**
  - There is too much important work to be done that the CCMC is uniquely suited for and uniquely qualified to lead, support, facilitate, and pursue.

Summary Assessment and the Future

- **CCMC has achieved the goal established for it a dozen years ago, to:**

  Develop and execute next generation research models in support of the advancement of space sciences and development of new operational space weather capabilities.

- **NASA is proud of CCMC's accomplishments and continues to support it in partnership with NSF and in service to science and multiple agencies.**

- **CCMC is an essential element of NASA's strategic investment to "Build the Knowledge to Forecast Space Weather Throughout the Heliosphere".**

- **The US national space weather enterprise needs a center to lead research leading to the improvements required for space weather forecasting.**

- **CCMC is already performing many of the functions of this center, and should take on this broader responsibility more directly and explicitly.**

CCMC has unique capabilities that should be expanded to increase its effectiveness and power to improve space weather forecasting.