The Community Coordinated Modeling Center:
An Overview

Michael Hesse

http://ccmc.gsfc.nasa.gov

**NASA Goddard Space Flight Center**

NASA

NSF
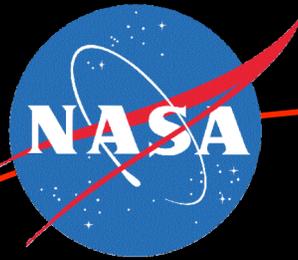
AFRL

AF/XOW - AFWA

"A US multi-agency partnership to enable, support, and perform the research and development for next generation space science and space weather models"

NOAA/SEC

AF SMC/CI

AFOSR

ONR

CCMC Activities

- Employ scientific research models to address National Space Weather needs

- Generate, with the research community, a flexible model chain, which addresses solar atmosphere to Earth's upper atmosphere

- Serve the research community through access to scientific model results ("open model policy")

- Perform broad-based testing and metrics-based evaluation of research models

- Make available science- and metrics-tested models to operational National Space Weather Agencies
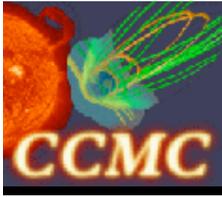
Decision Flow

US National Space Weather Program Council

US Committee for Space Weather

CCMC steering committee

Research Community — **recommendations, needs** →

Operations Community — **needs requirements** →

directs ↓   **informs** ↑

Science and Operations Advisory Committees

CCMC Steering Committee

Members:

AF/XOW	Maj. Mark Adair
AFOSR	Maj. David Byers
AFRL	Dr. Nick Arge
NASA/GSFC	Dr. Michael Hesse
NASA Headquarters	Dr. Madhulika Guhathakurta
	Dr. Chuck Holmes (Co-Chair)
NOAA	Dr. Terry Onsager
NSF	Dr. Paul Bellaire (Co-Chair)
	Dr. Bob Robinson
ONR	Dr. Bob McCoy
SMC/CI	Mr. Kevin Scro (Facilitator)

Technical Advisors:

AFIT	Maj. Devin Della-Rose
AFSPC	Mr. Kelly Hand

CCMC Implementation

Staff

Approx. 10FTE

Facility

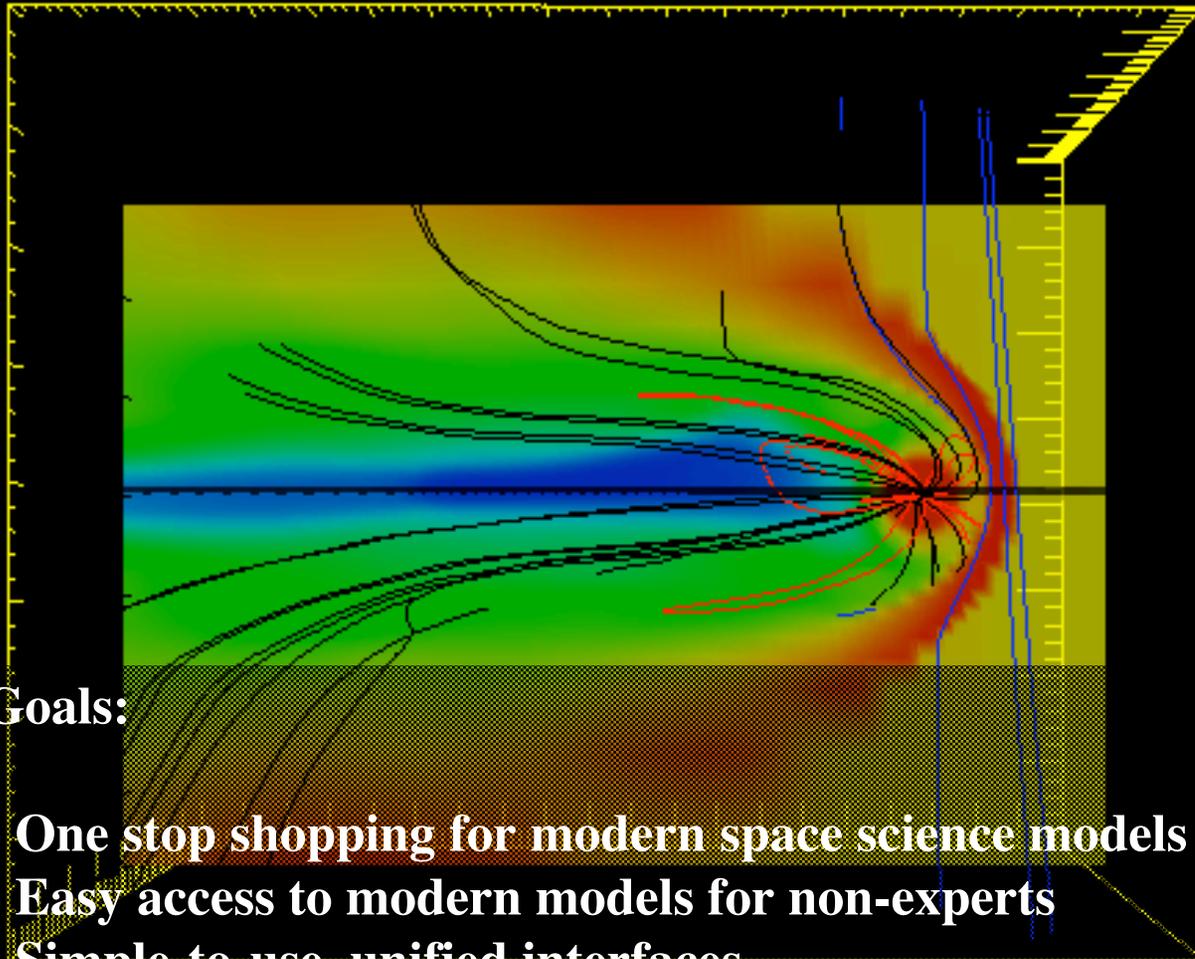Dedicated laboratory, located at NASA GSFC/B21

Computational resources

200 node Beowulf cluster, supported by USAF and NSF
USAF high performance computing centers

CCMC Functions: Research Support

Goals:

- **One stop shopping for modern space science models**
- **Easy access to modern models for non-experts**
- **Simple-to-use, unified interfaces**
- **Advanced, tailored visualization tools**
- **Continuous improvements through user feedback**

Service

- Through www-accessible run results

- Through runs on request (>500 now), available for

  - 4 magnetospheric models
    (OPEN-GGCM, BATSRUS, Fok-RC, Fok-RB)
  - 3 ionospheric models
    (Weimer, SAMI-2, CTIP)
  - 4 heliospheric models
    (IPS, IASB exospheric,ENLIL, WSA)
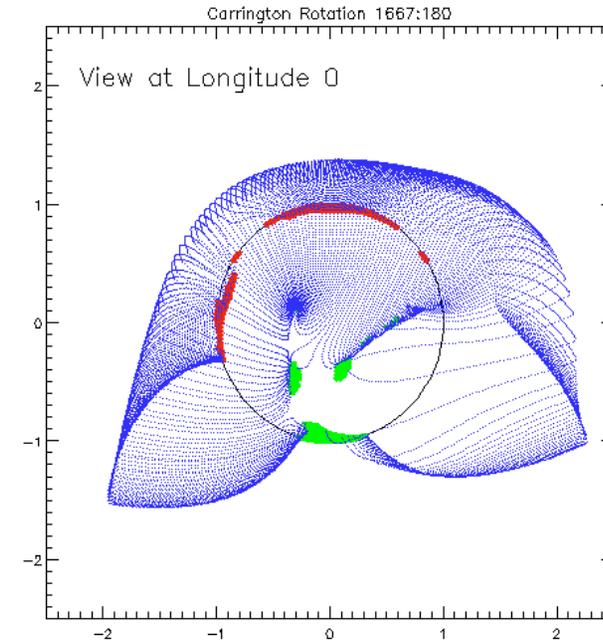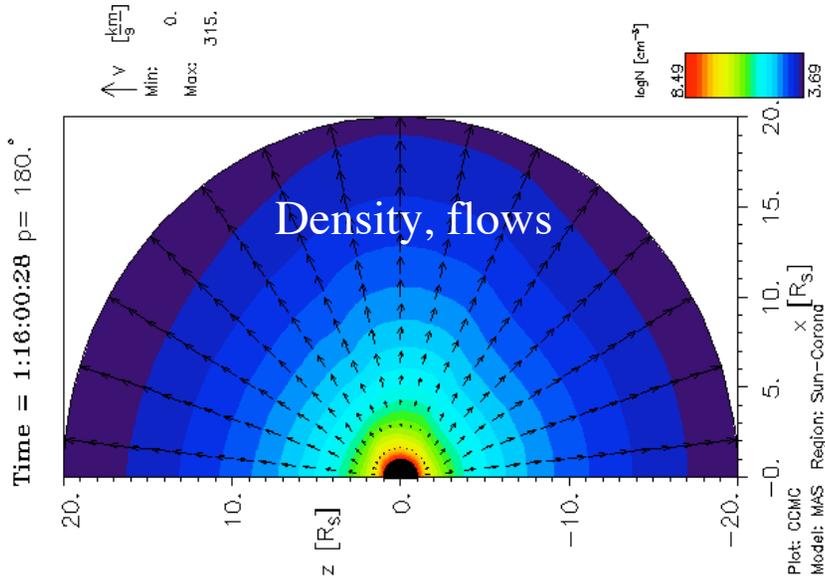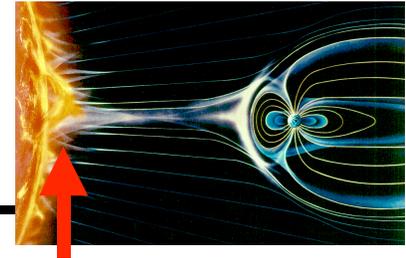 - 2 solar models
    (MAS, Luhmann)

- No cost to user

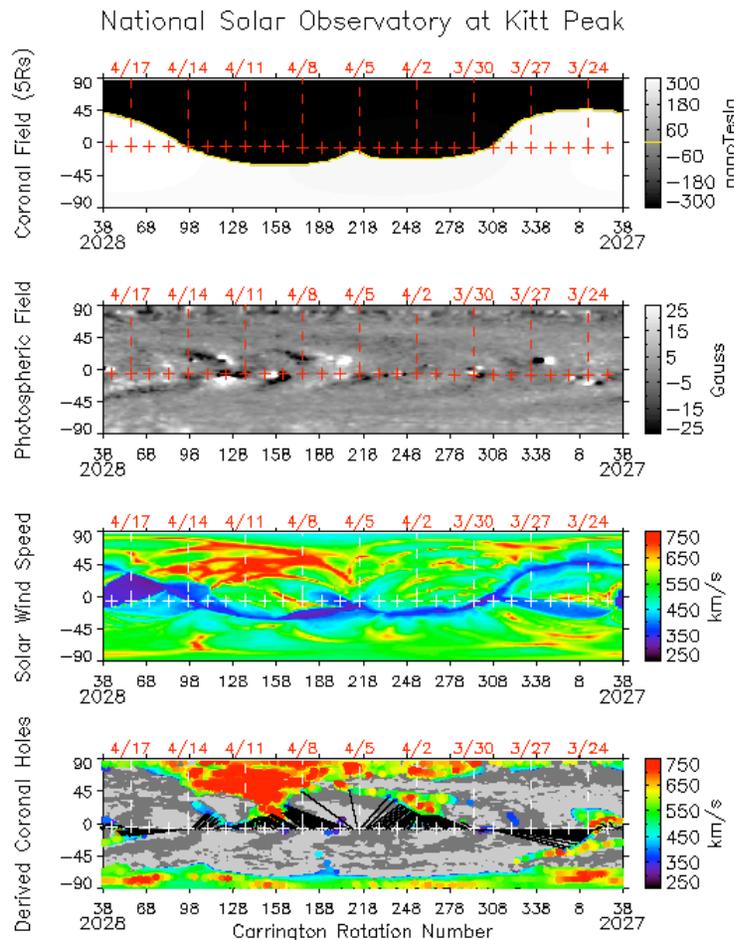http://ccmc.gsfc.nasa.gov
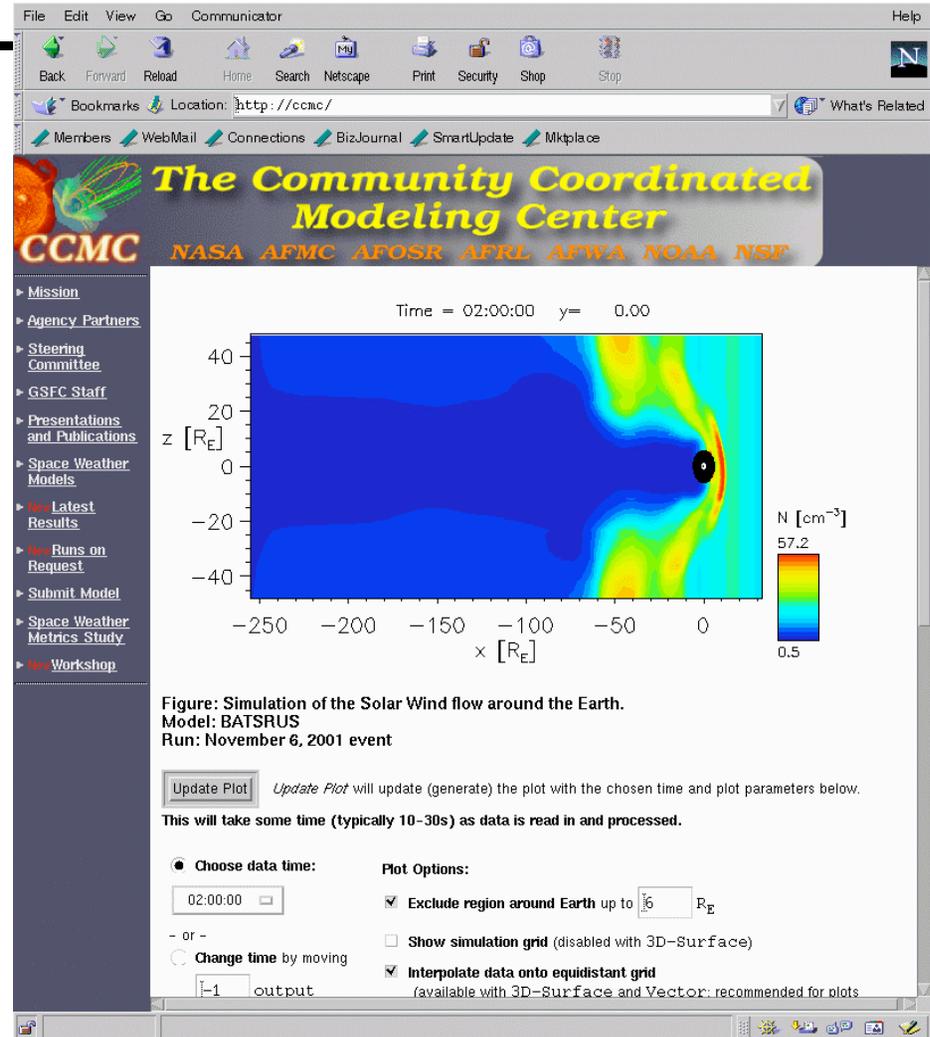
Models: Overview
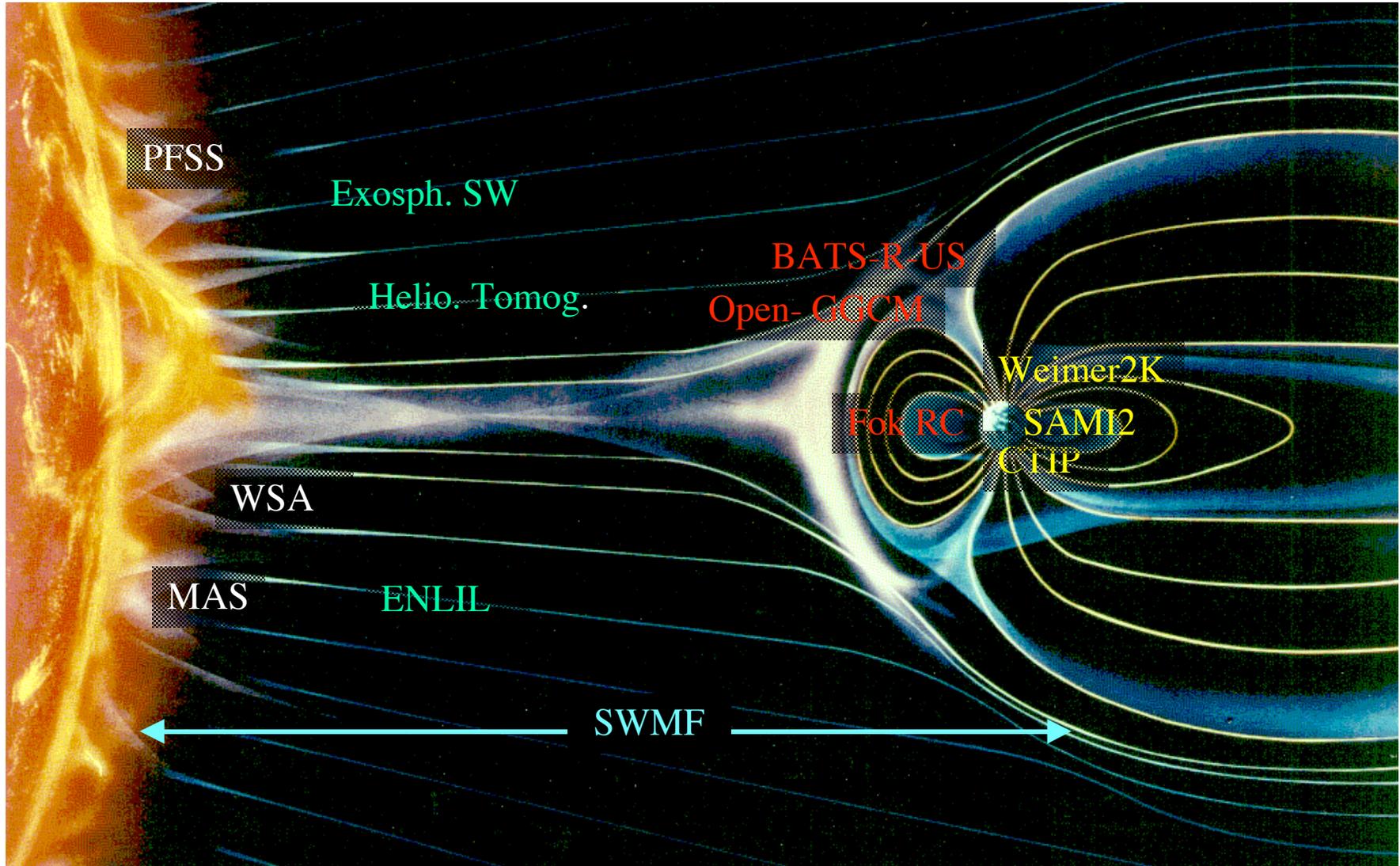
Solar Models

MAS (Linker et al – SAIC) – Global solar magnetic field and plasma structure

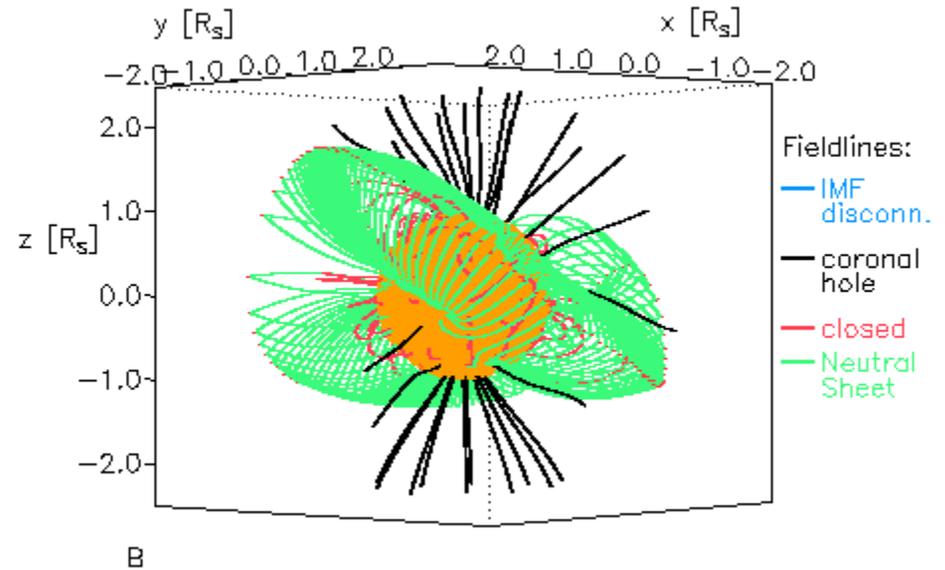- **Potential Field Source Surface** (Luhmann, UCB) - Global solar magnetic field structure

P. MacNeice, L. Rastaetter

Solar/Heliospheric Models

WSA (Wang-Sheeley-**Arge**) – PFSS corona + 'potential' current sheet + empirical kinematic solar wind

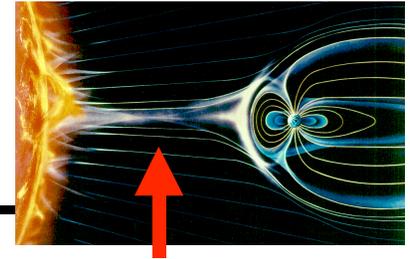# Heliospheric Models

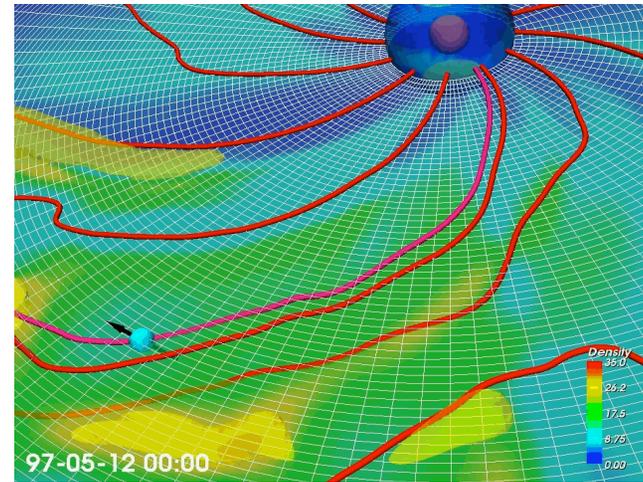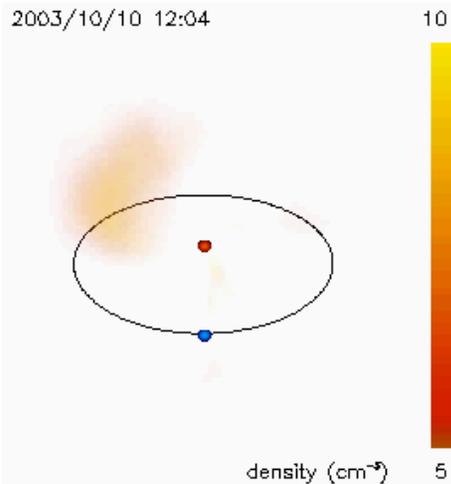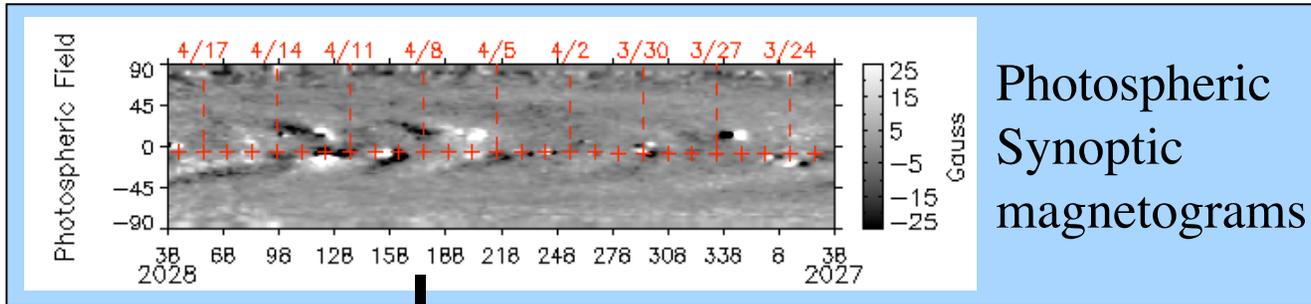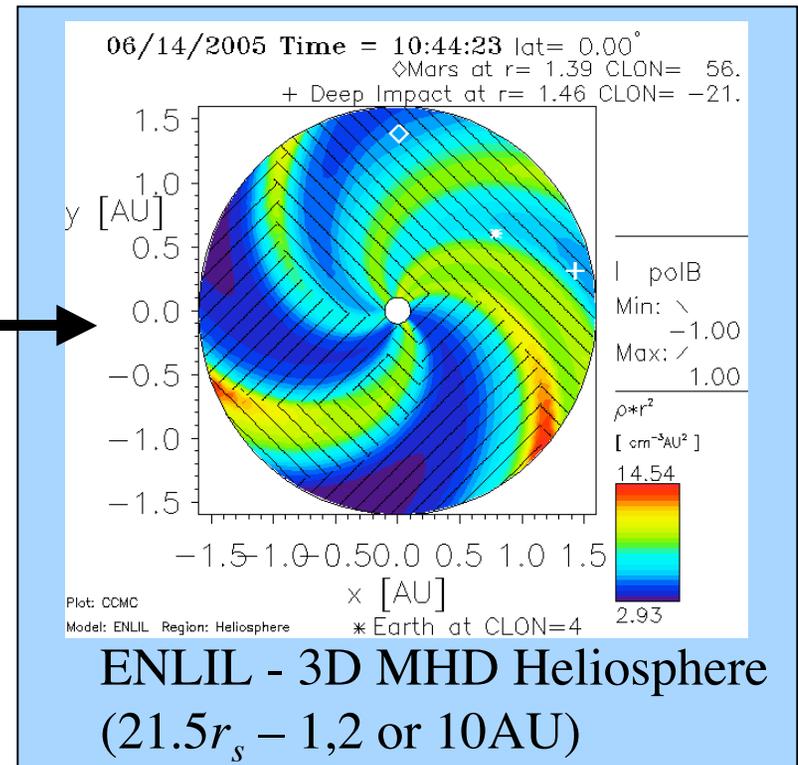- **ENLIL (Odstrcil – NOAA) –** 3D MHD model of inner heliosphere ($30r_s$ – 10AU) .

- **Heliospheric Tomography (Jackson,Hick – UCSD)** – Constructs global mass and velocity distribution from a simple kinematic model and assimilation of radio scintillation data.

• Exospheric Solar Wind Model (Lamy/Pierrard) – 1D kinetic model of solar wind solution along a coronal hole fieldline.

Forecasting : Sun to Earth

Photospheric Synoptic magnetograms

Running in realtime,

collab. With CISM

P. MacNeice, L. Rastaetter

WSA – potential field + equatorial current sheet model (1-21.5r_s)

ENLIL - 3D MHD Heliosphere (21.5r_s – 1,2 or 10AU)
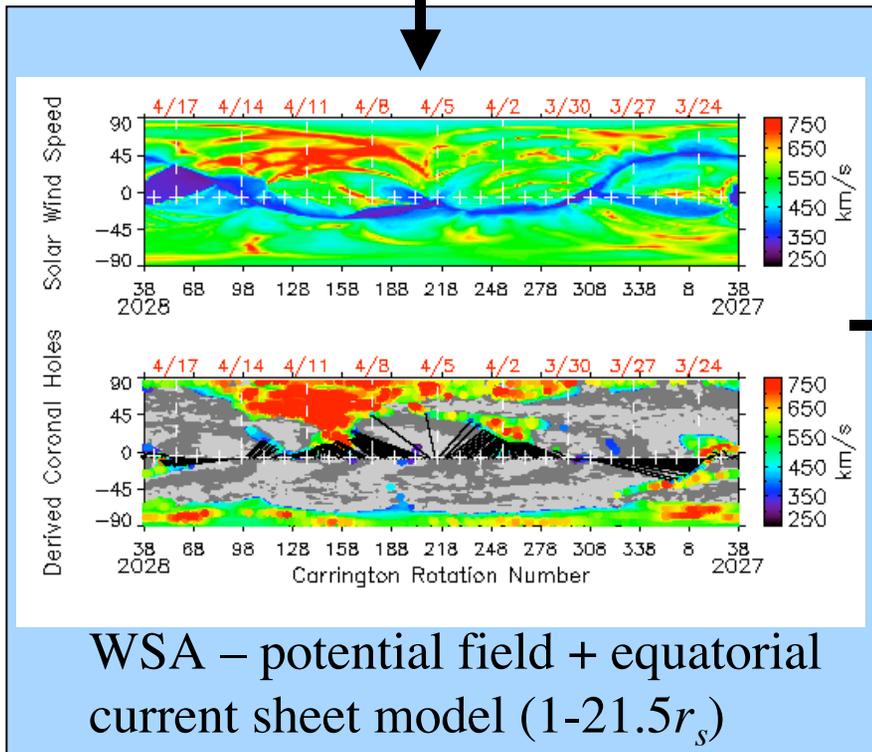
Frameworks at CCMC
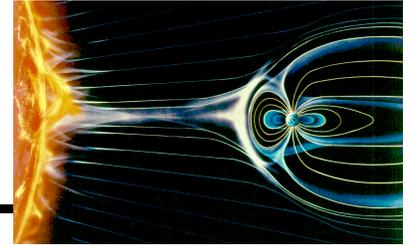
- SWMF (*Gombosi et al,* Univ. of Mich.) – in implementation

  SC, IH, GM – BATS-R-US

  SP – Kota's SEP or FLAMPA

  IM – Rice Convection Model (RCM)

  RB – Rice RBM

  IE – Ridley Ionosphere

  UA – Global Iono. Thermosp. Model (GITM)

- CISM (*Hughes et al.*) – collaboration initiated.

Key Usage Statistics

- Online database of Runs on Requests

  – Number of runs submitted: 500 over 3 years

- Web site statistics for 2004

  – 10,000 hits/month

  – 420 unique visitors/month

  – 1,500 visualization requests/mo

- International resource

Domains/Countries		Pages	Hits
USA Educational	edu	1000	1716
USA Government	gov	529	801
Czech Republic	cz	493	917
Network	net	491	855
Commercial	com	348	405
Denmark	dk	193	274
USA Military	mil	192	264
United Kingdom	uk	40	60
Bulgaria	bg	30	42
Belgium	be	29	46
Non-Profit Organizations	org	22	29
Argentina	ar	19	34
Finland	fi	13	29
Italy	it	12	21
Japan	jp	10	20
Germany	de	8	13

Visitors domains/countries

Transition to Ops: V&V and Metrics

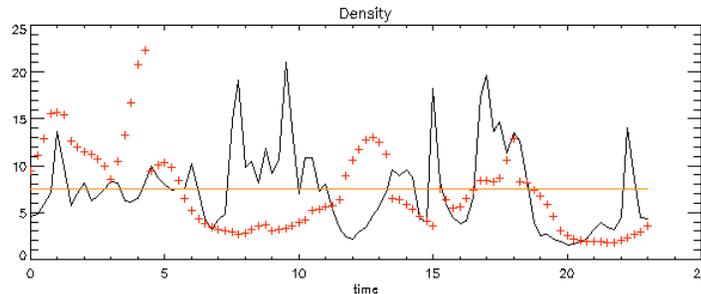Decision makers and operational agencies need model evaluations

- Science-based validation: Compare model output to measurements for select events, detailed analysis

- Metrics studies: Repeatable comparison between model output and measurements, "one number"

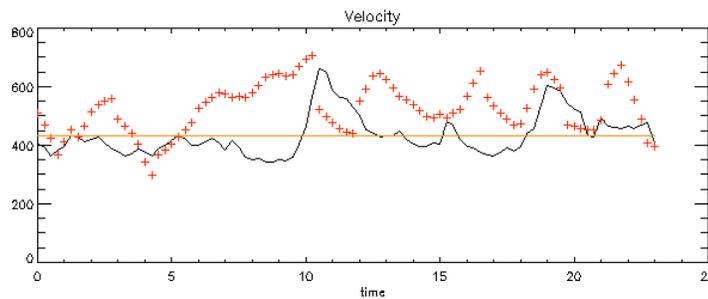**Need to be blind studies, performed by independent agent**

Metrics: Heliospheric Tomography
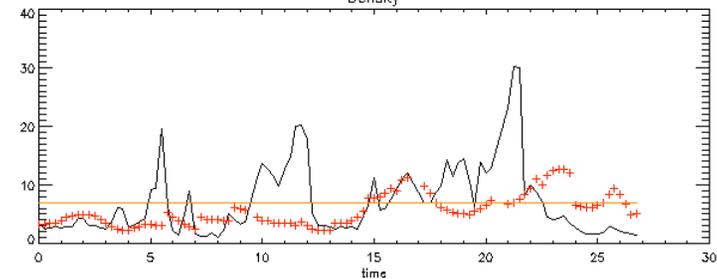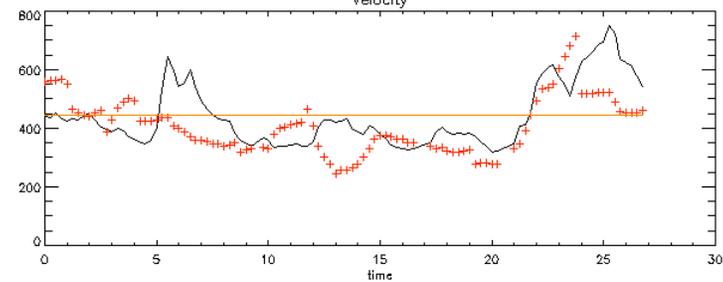

Density

Velocity

Time (Days)

Time (Days)

Period 1

Period 2

Black: Data   Red: Model   Orange: Mean

UCSD Heltomo model

Future Plans

- Support NSWP, Living With a Star, DoD Space Weather Transition Plan
  - Support and undertake R&D for advanced space weather models
- Establish closer collaborations with model owners
- CCMC participation in education
  - AFIT graduate students
  - USAF Academy
- Expand strong service to (international) research community
  - Increase solar and heliospheric model contingent
- Provide expanded, independent model evaluations
  - Work with researchers and operators to identify suitable metrics
- Continue and expand model transfer to operational agencies
- Looking for new users and for user feedback