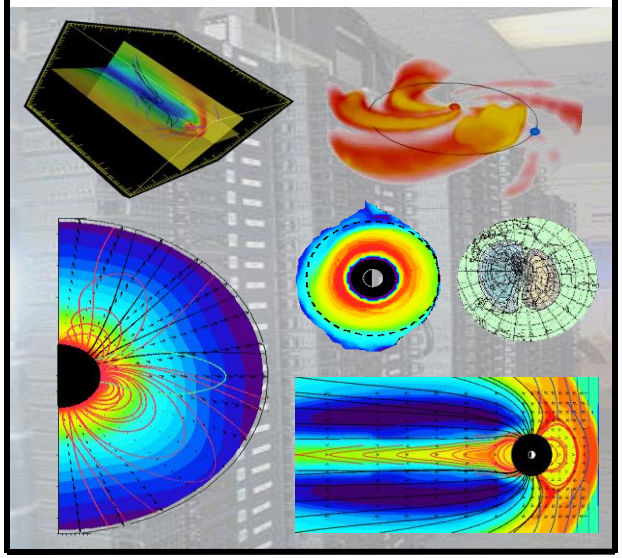
COMMUNITY COORDINATED MODELING CENTER



Tools and Products of Real-time Modeling: Opportunities for Space Weather Forecasting

Michael Hesse
and the CCMC Team

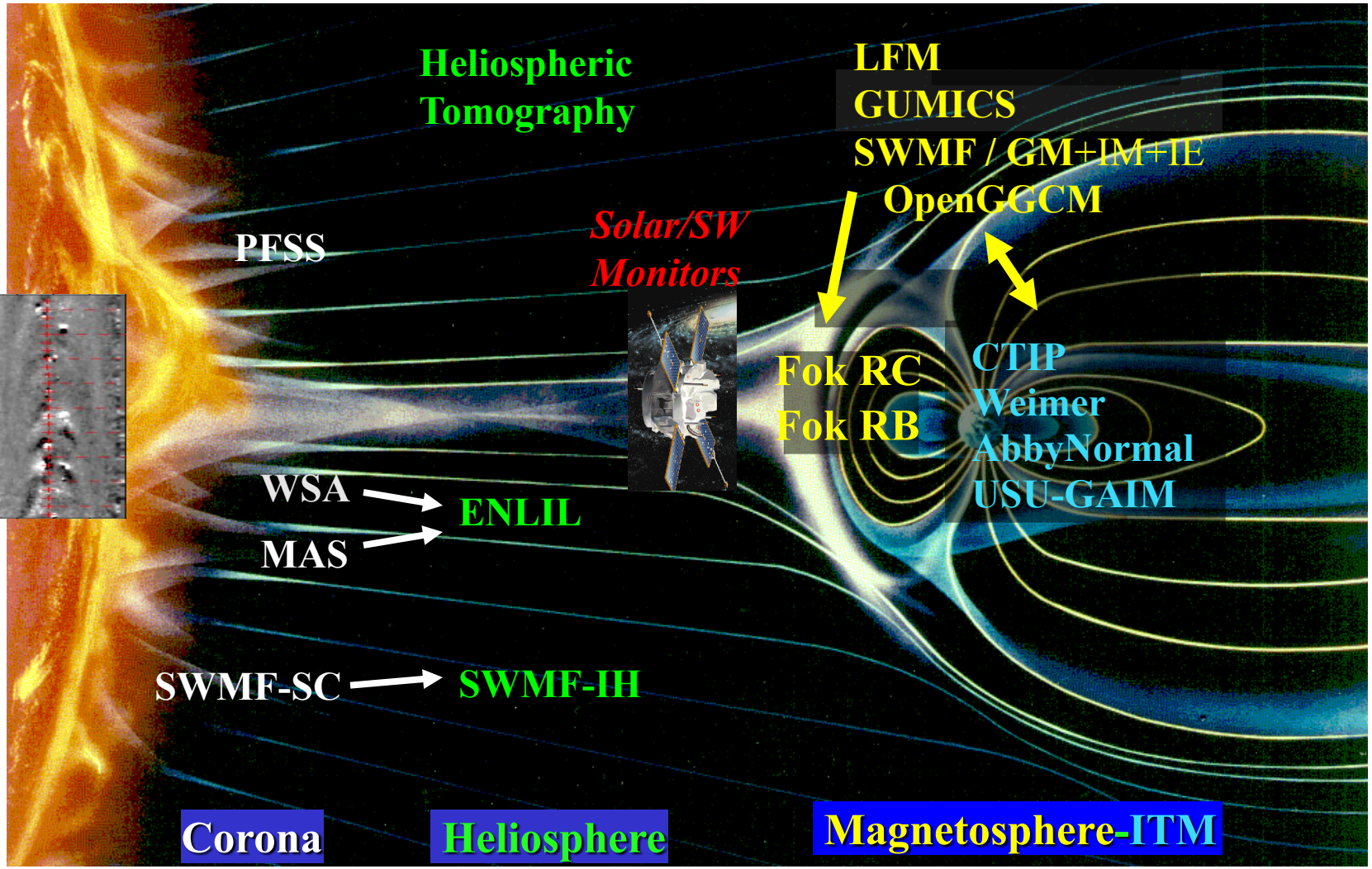
Community Coordinated Modeling Center

Space Weather Laboratory

NASA Goddard Space Flight Center

CCMC Staff

Models hosted by CCMC

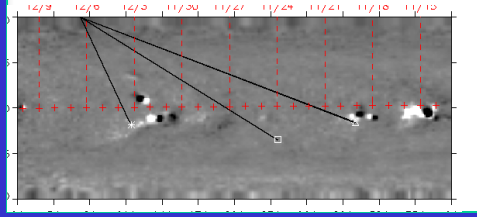


Unique breadth

Tools and Products

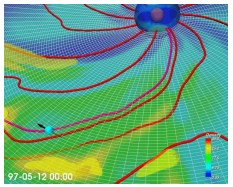
Bootstrapping:

Model run at CCMC

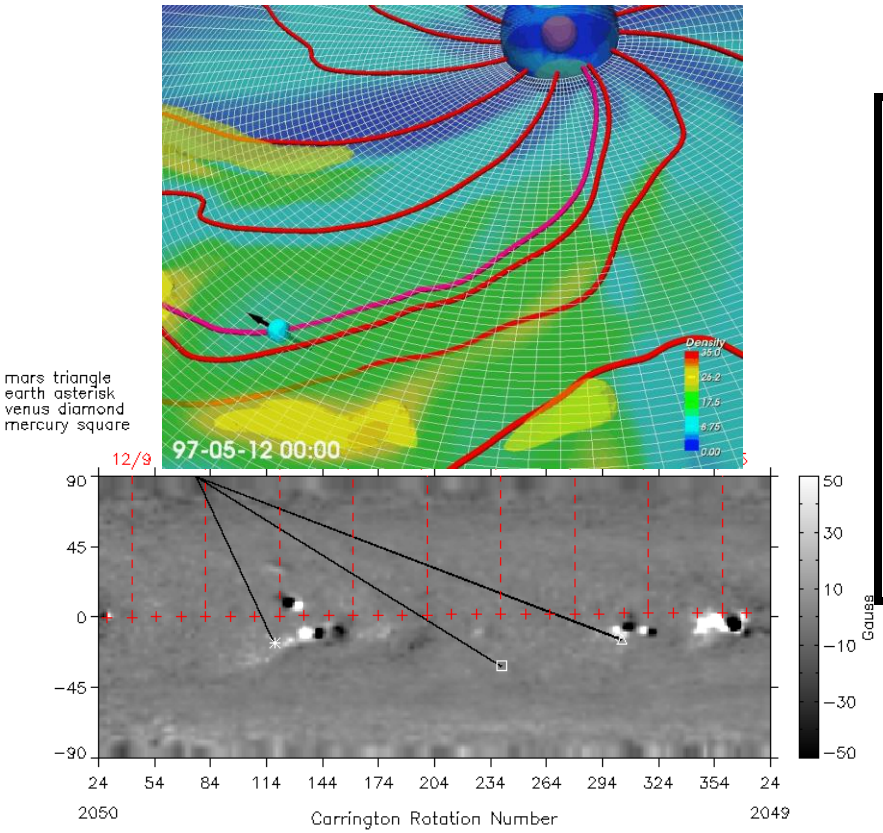


Tool used at AFWA, SWPC, …
Customer feedback

Model run at forecasting centers

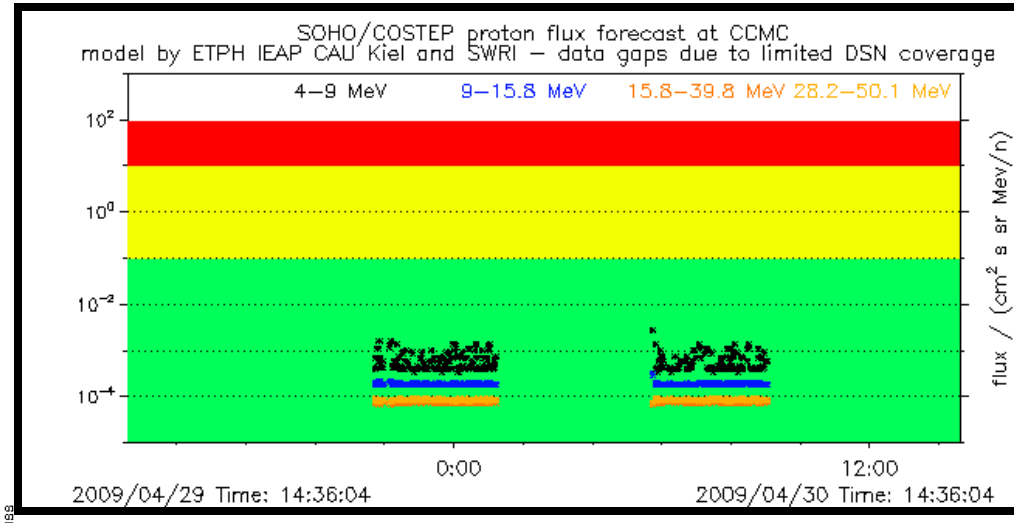


Presently Available Tools



Sun-Earth magnetic connection:
SEP green-yellow
Updated daily

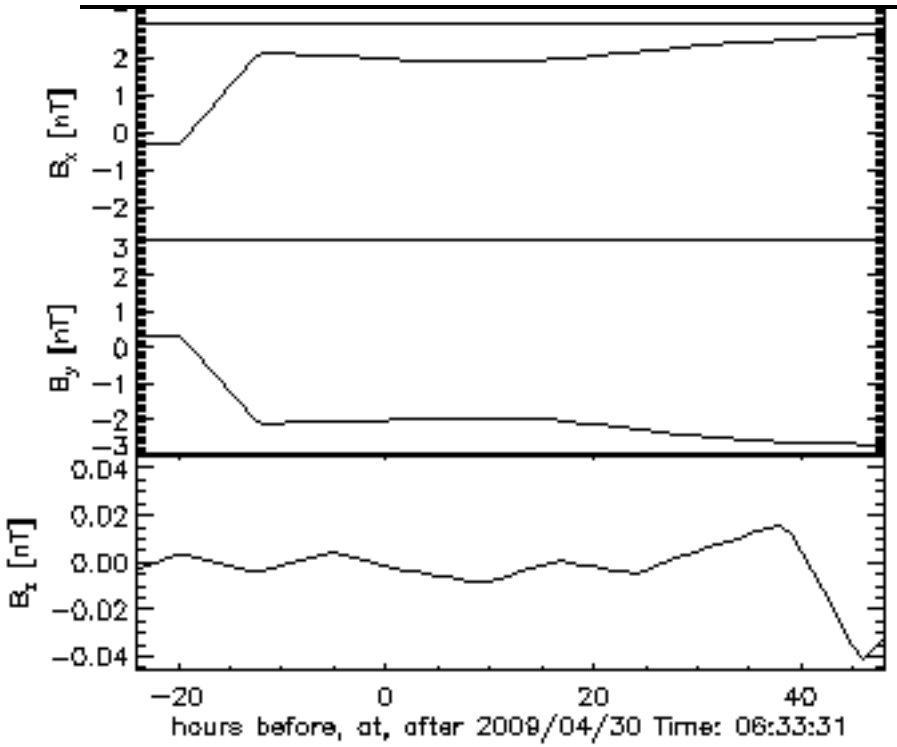
Model: WSA/ENLIL N. Arge, D. Odstrcil (CISM)

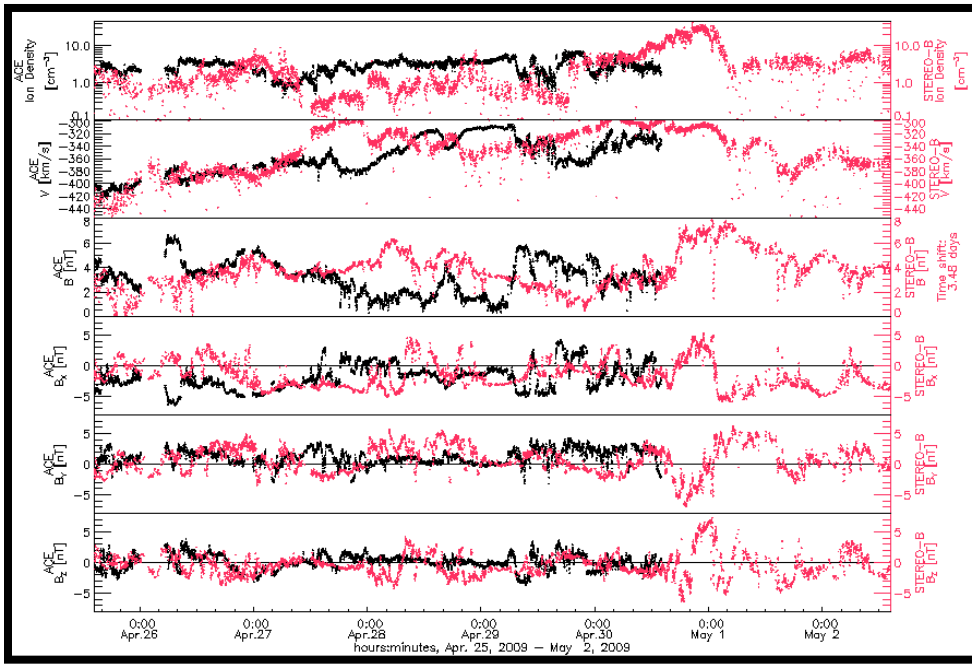


SEP Warning:
SEP red
Updated dep't on SOHO data
1 hour warning

Model: A. Posner (NASA,SWRI)

Presently Available Tools





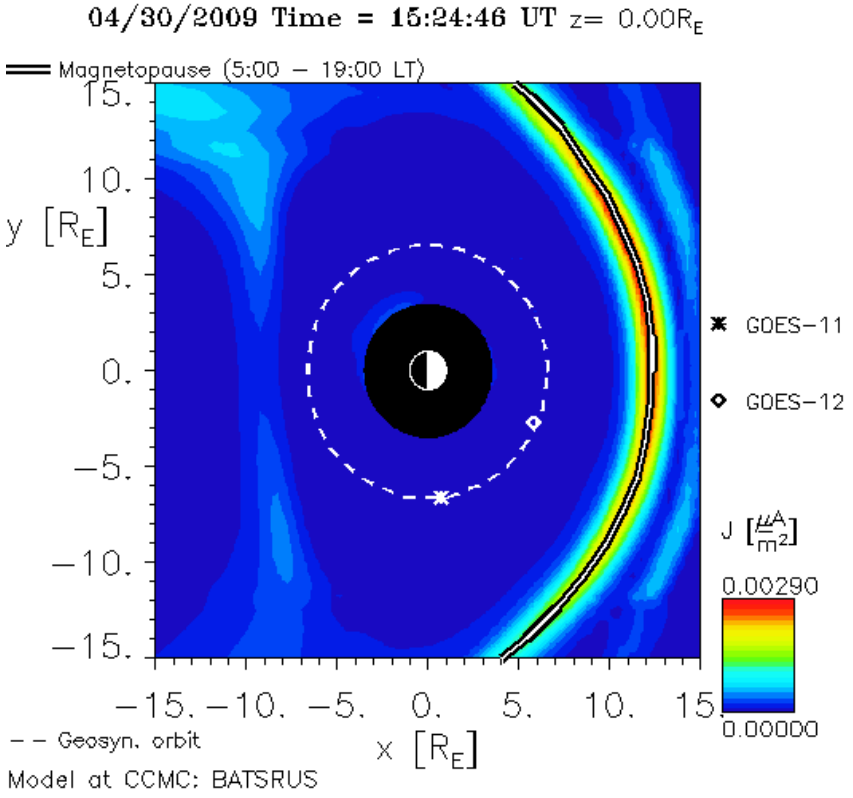
L1 Plasma and magnetic field:
Geomagnetic storm forecast
Includes CME forecast
Up to 48h forecast
Updated daily/on CME obs.

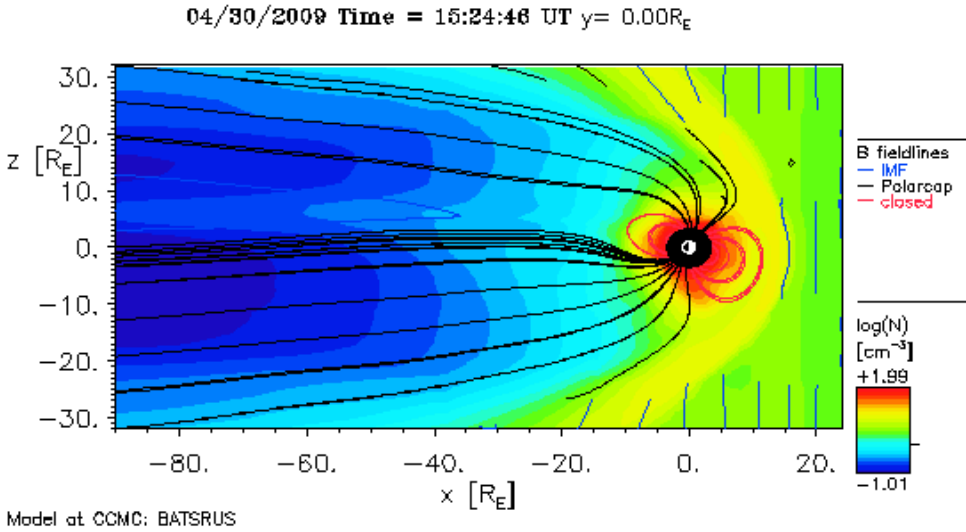
Model: WSA/ENLIL N. Arge, D. Odstrcil (CISM)

Solar wind forecast:
Based on STEREO behind
~48h forecast

Source: STEREO, ACE (NASA)

Presently Available Tools



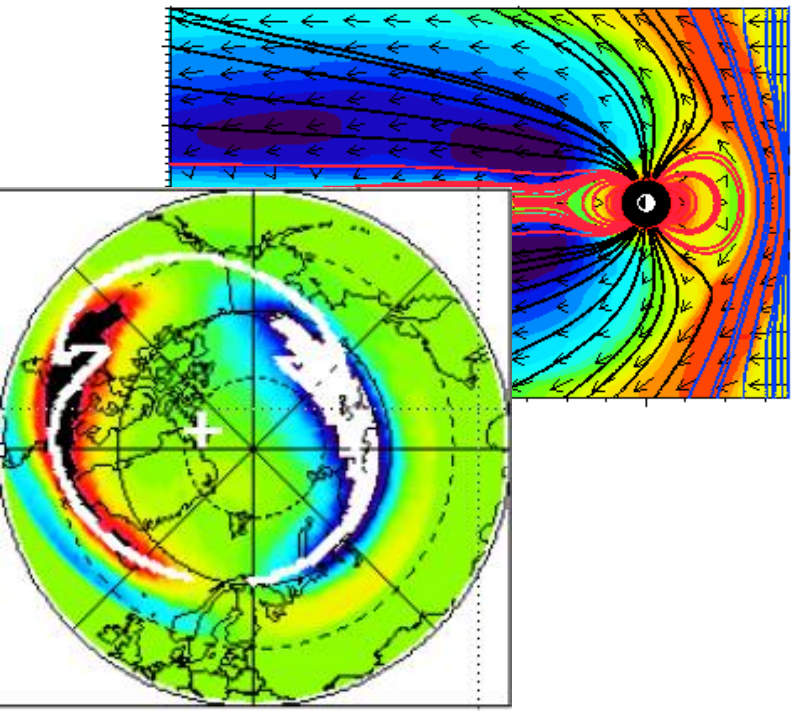


Magnetopause position:
S/C orientation
Updated every 4mins
~45min forecast

1-10keV plasma density:
S/C charging
Updated every 4mins
~45min forecast

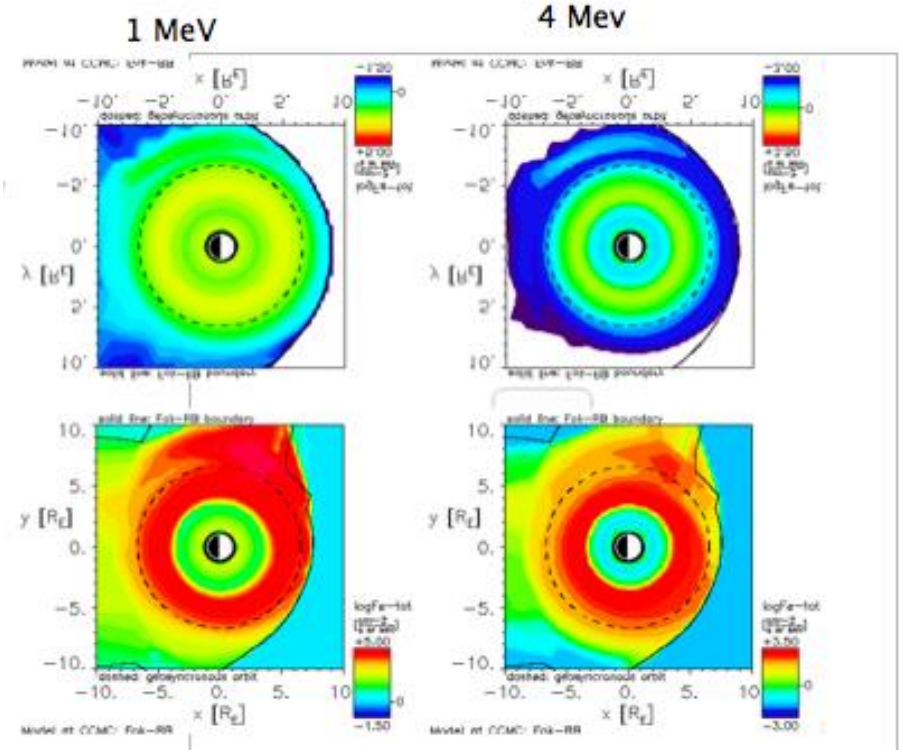
Model: SWMF T. Gombosi et al. (CSEM)

Presently Available Tools



Radiation access to upper atmosphere:
PC Absorption, high flyer
Updated ~4mins
~45min forecast

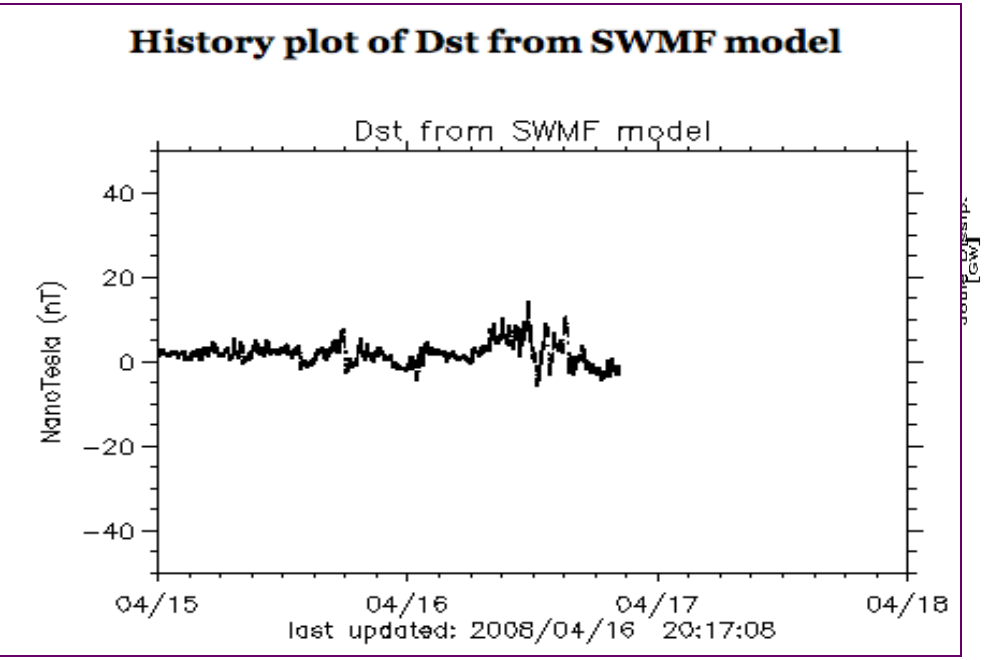
Model: SWMF T. Gombosi et al. (CSEM)

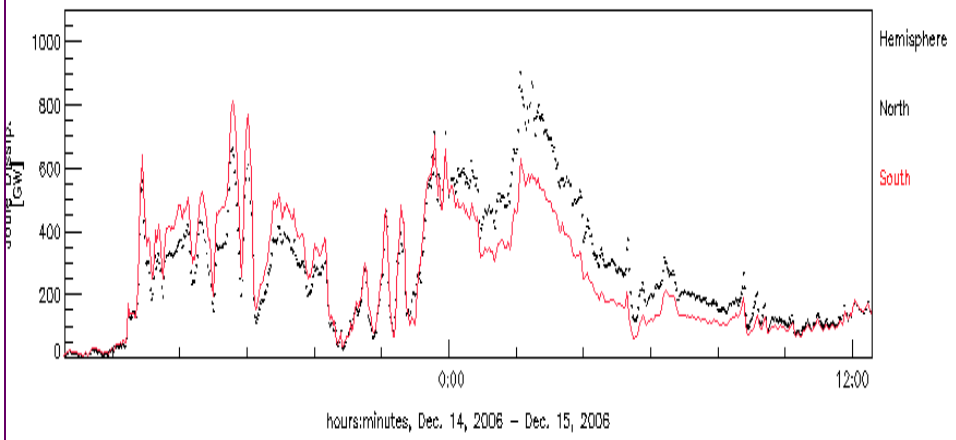


1keV-10MeV electron fluxes:
S/C charging, SEU, radiation hazards
Updated every 4mins
~45min forecast

Model: RC/RB M-C Fok (GSFC)

Presently Available Tools



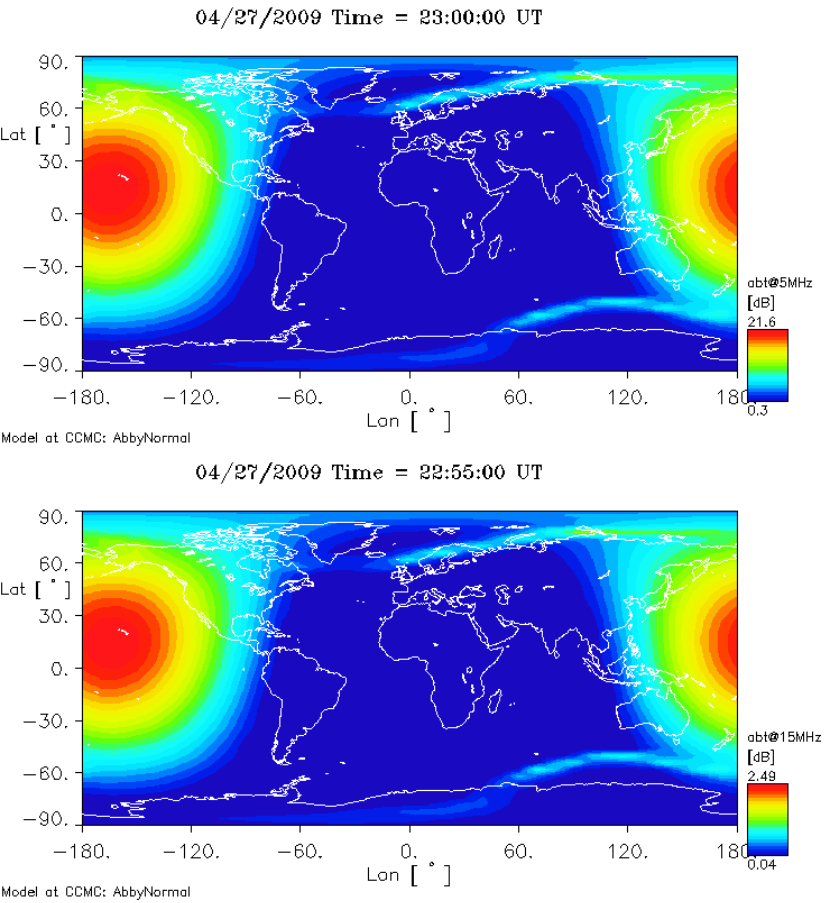


Dst:
Input for various products
Updated ~4mins
~45min forecast

Atmospheric Joule heating:
Atmospheric drag
Updated ~4mins
~45min forecast

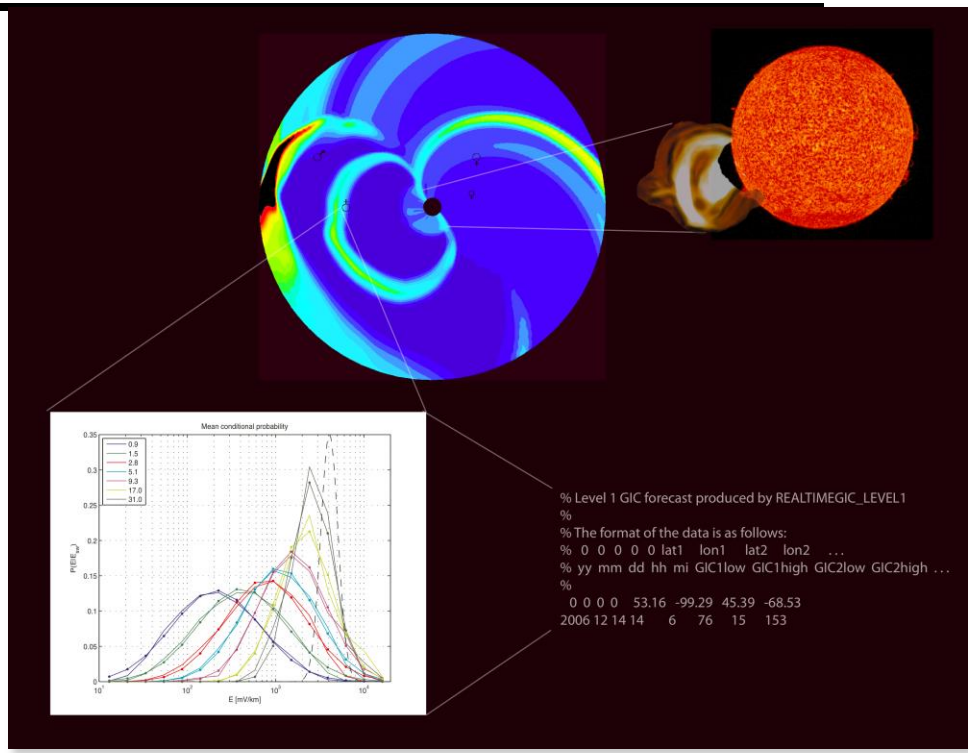
Model: SWMF T. Gombosi et al. (CSEM)

Presently Available Tools



HF absorption:
Executing in real-time

Model: AbbyNormal V. Eccles (USU)



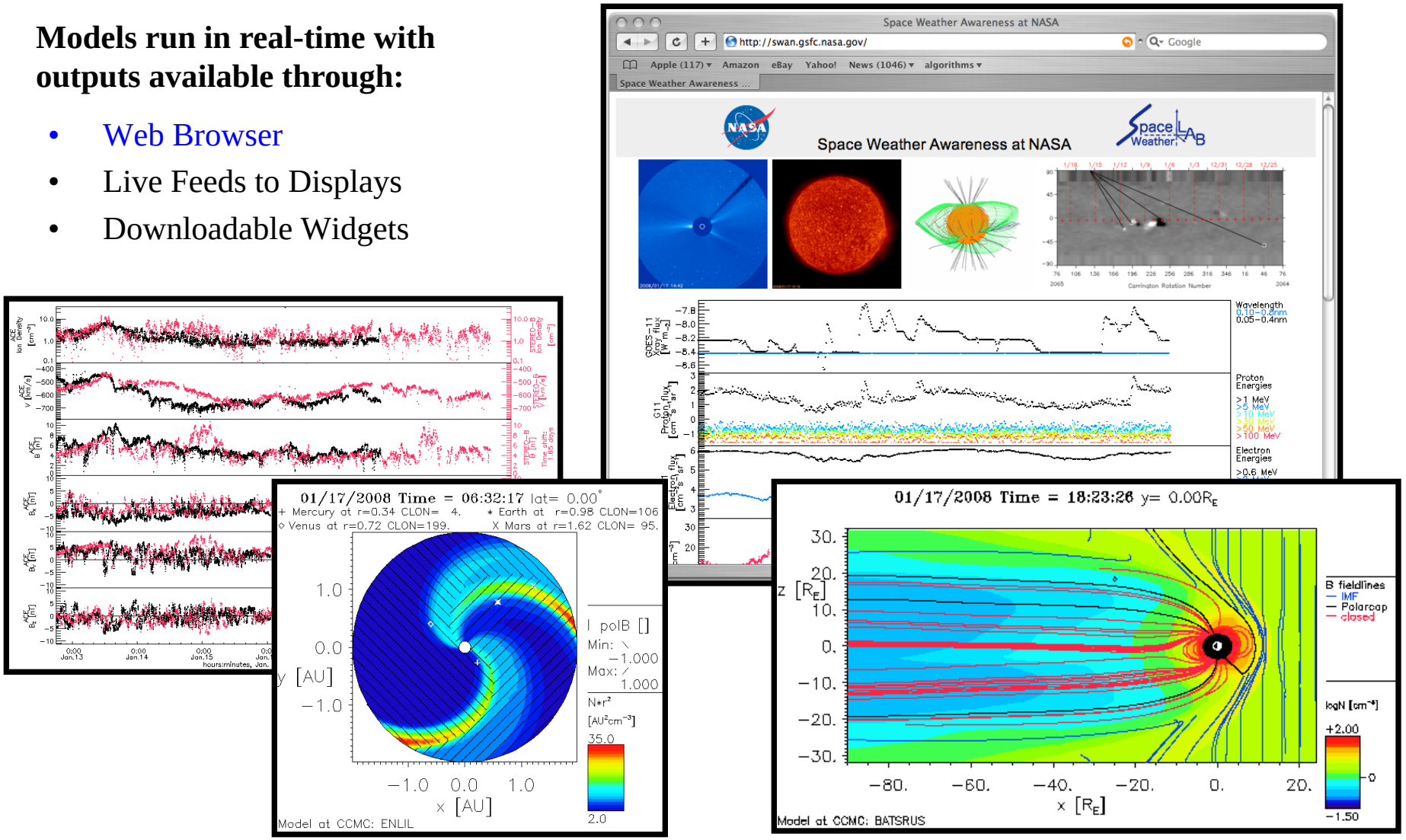
GIC Warning:
Electric power grid safety
Updated every 4mins
~45min forecast
Different mode for CME events

Model: WSA/ENLIL, SWMF, A. Pulkkinen

Experimental real-time tools:
http://swan.gsfc.nasa.gov

Models run in real-time with outputs available through:

- Web Browser
- Live Feeds to Displays
- Downloadable Widgets



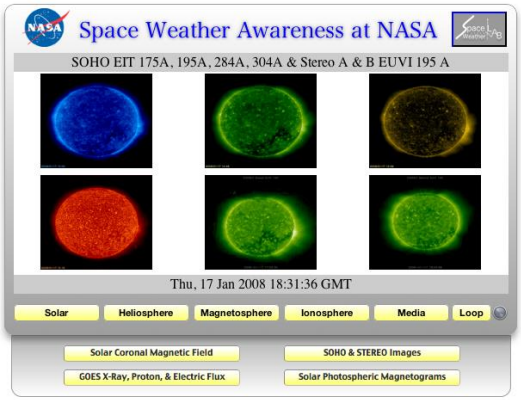
D. Berrios, M. Maddox, L. Rastaetter

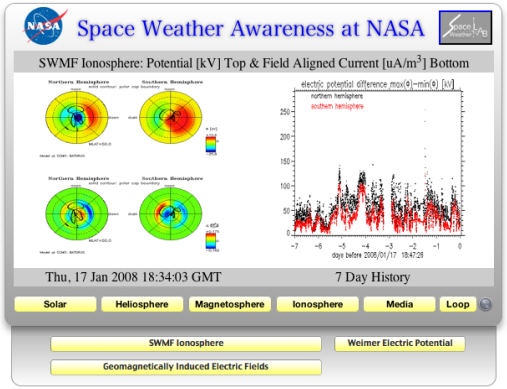
Widgets

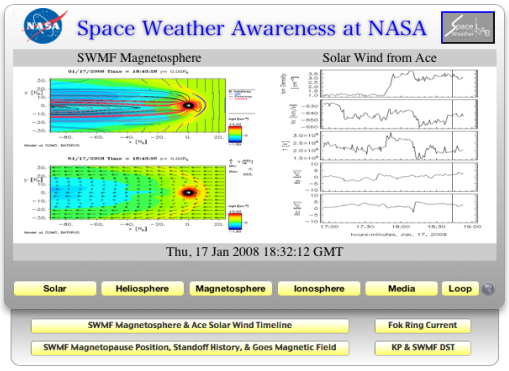
Models run in real-time with outputs available through:

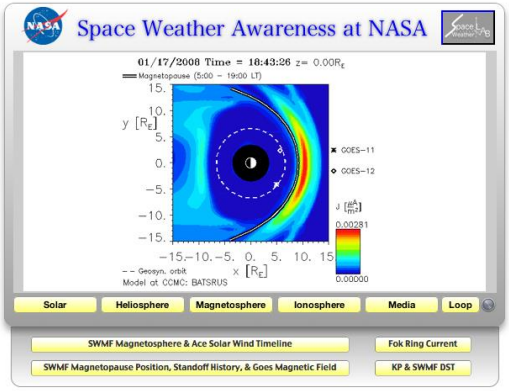
http://ccmc.gsfc.nasa.gov/downloads/

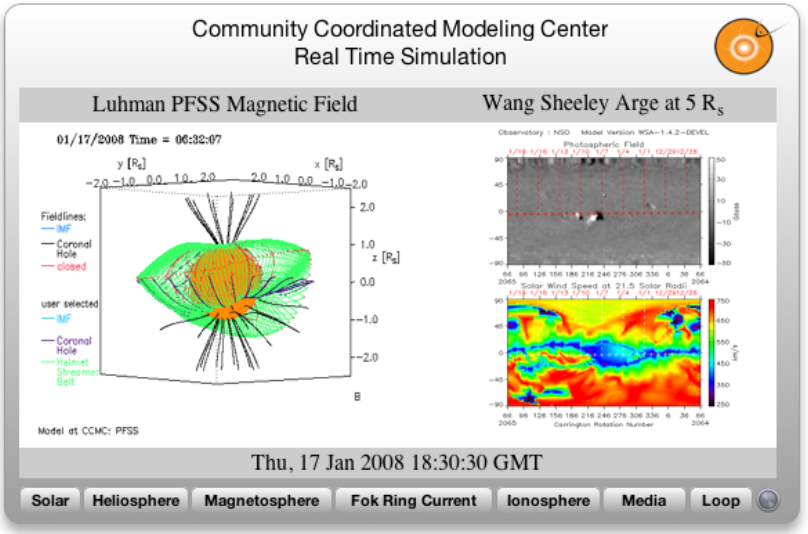
- Web Browser
- Live Feeds to Displays
- **Downloadable Widgets**





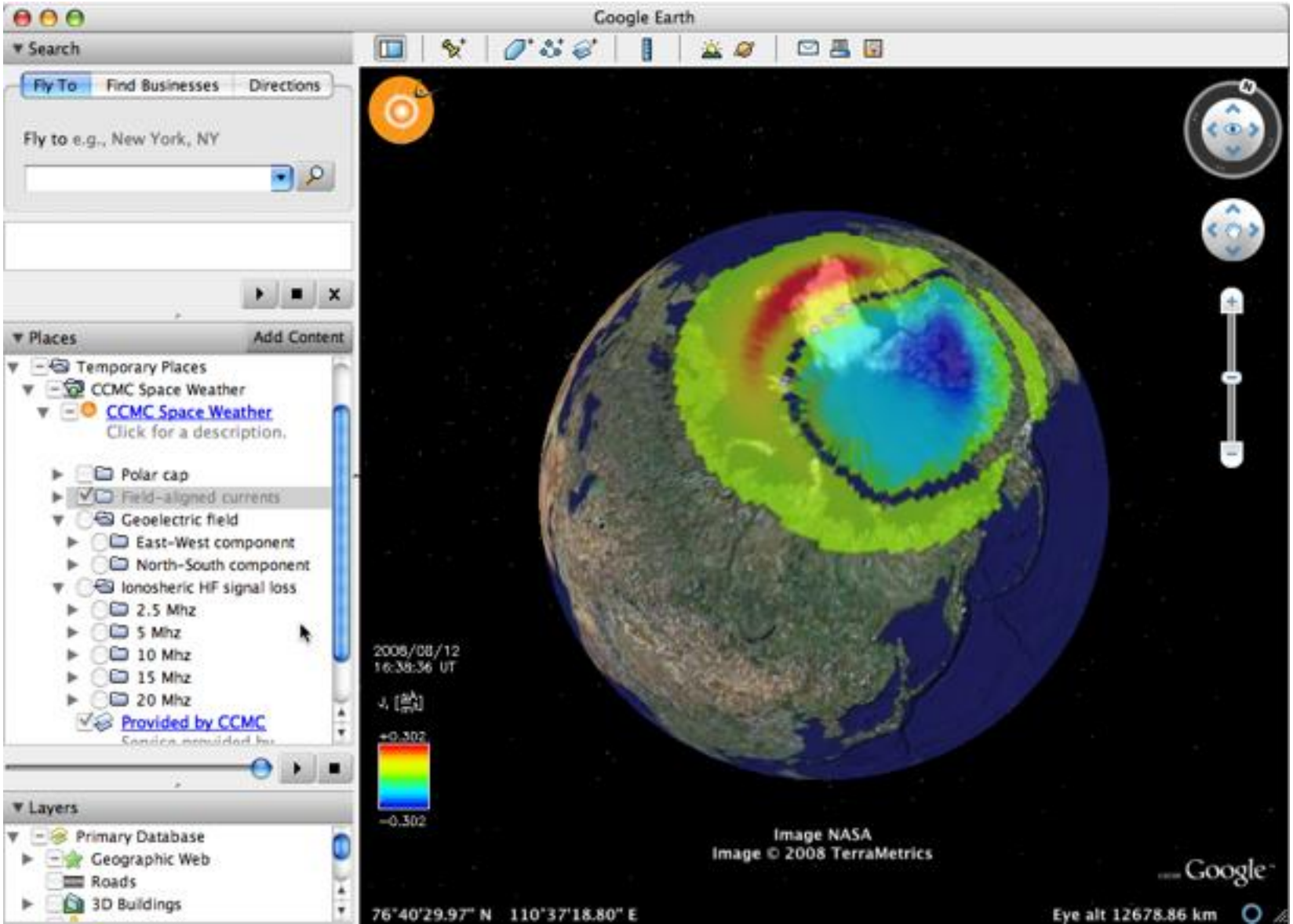




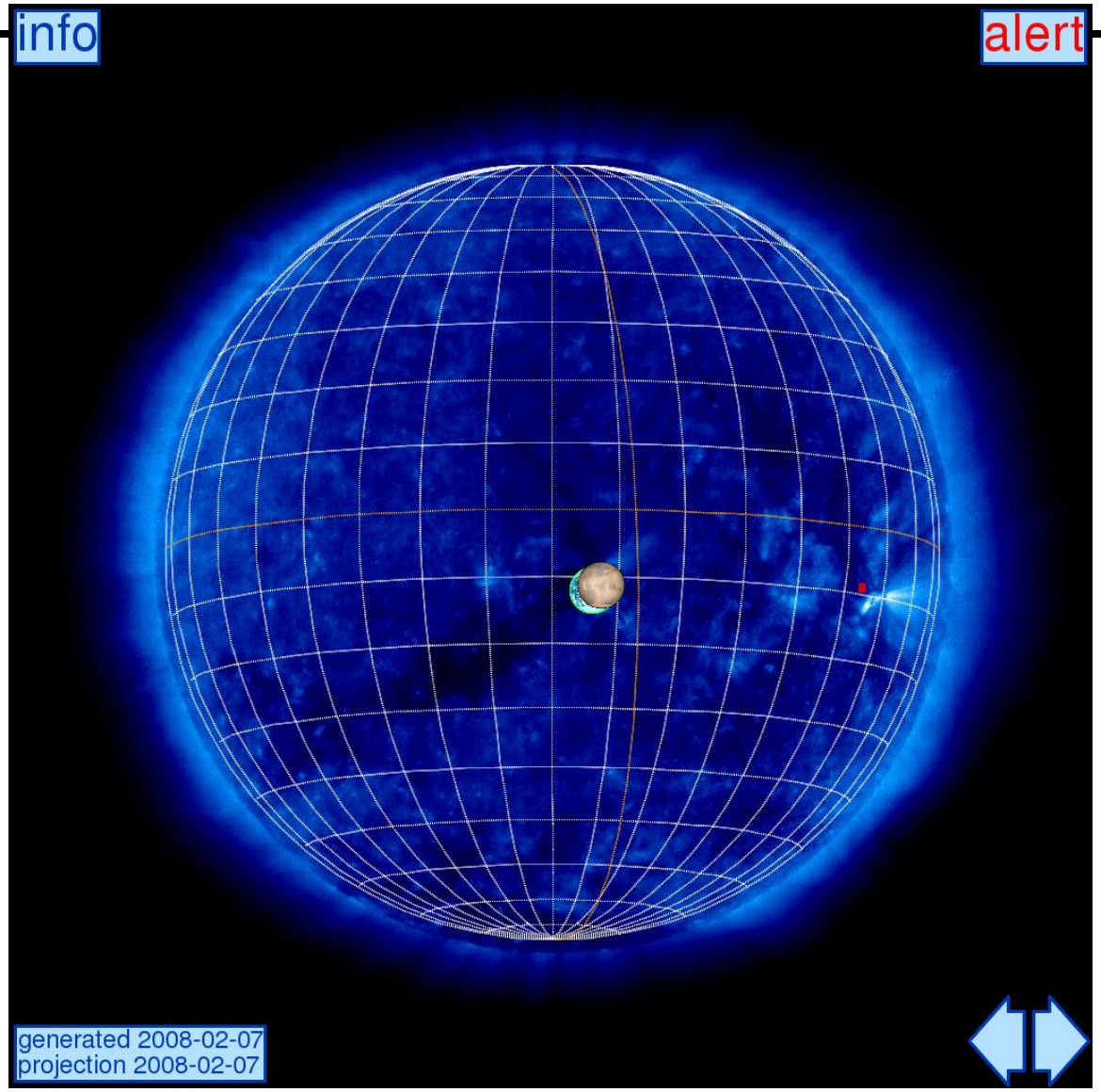


M. Maddox, R. Monroe , L. Rastaetter

Innovative dissemination: Google Earth



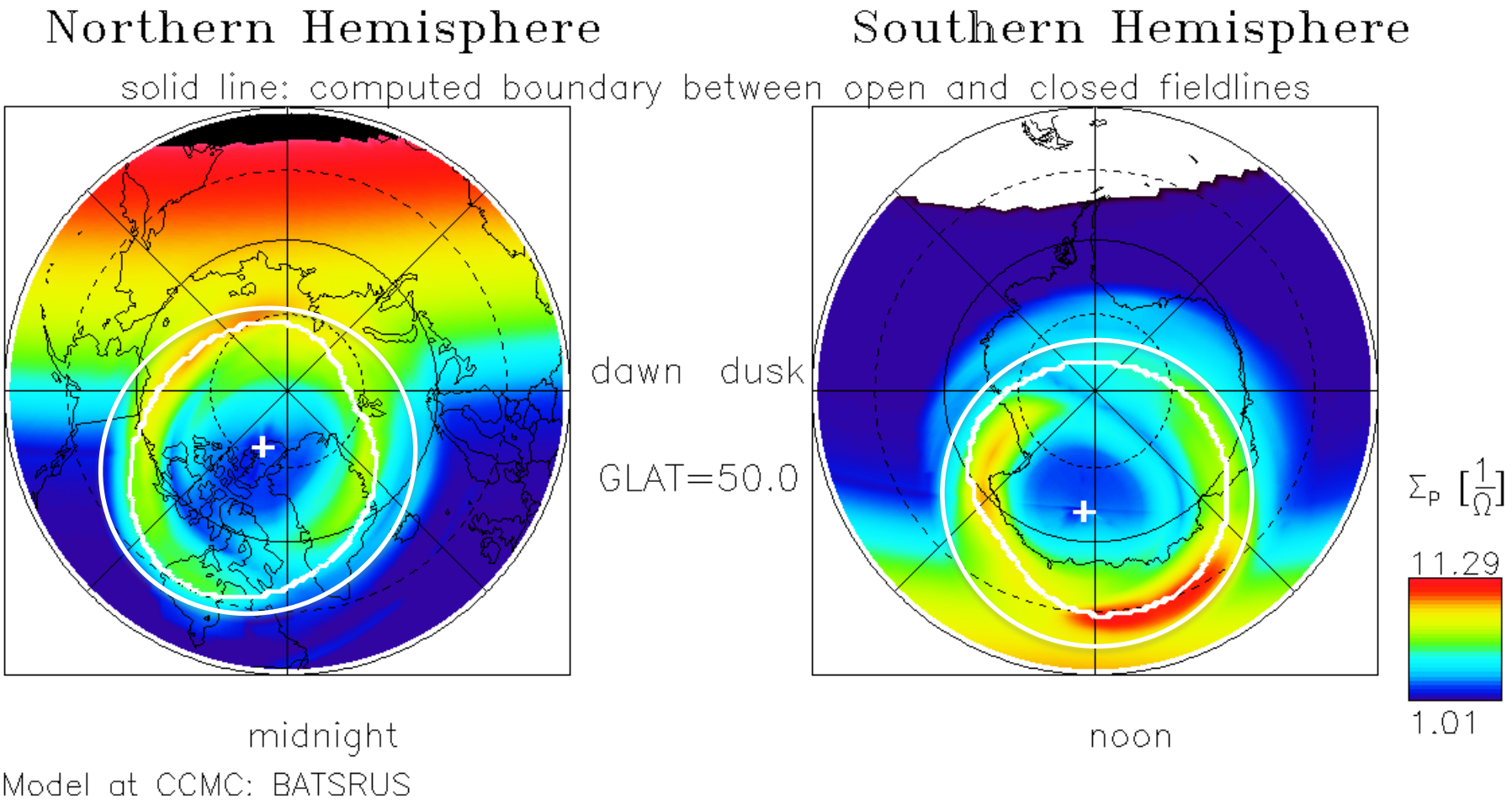
Innovative dissemination: iSWAN



http://ccmc.gsfc.nasa.gov/iSWA/

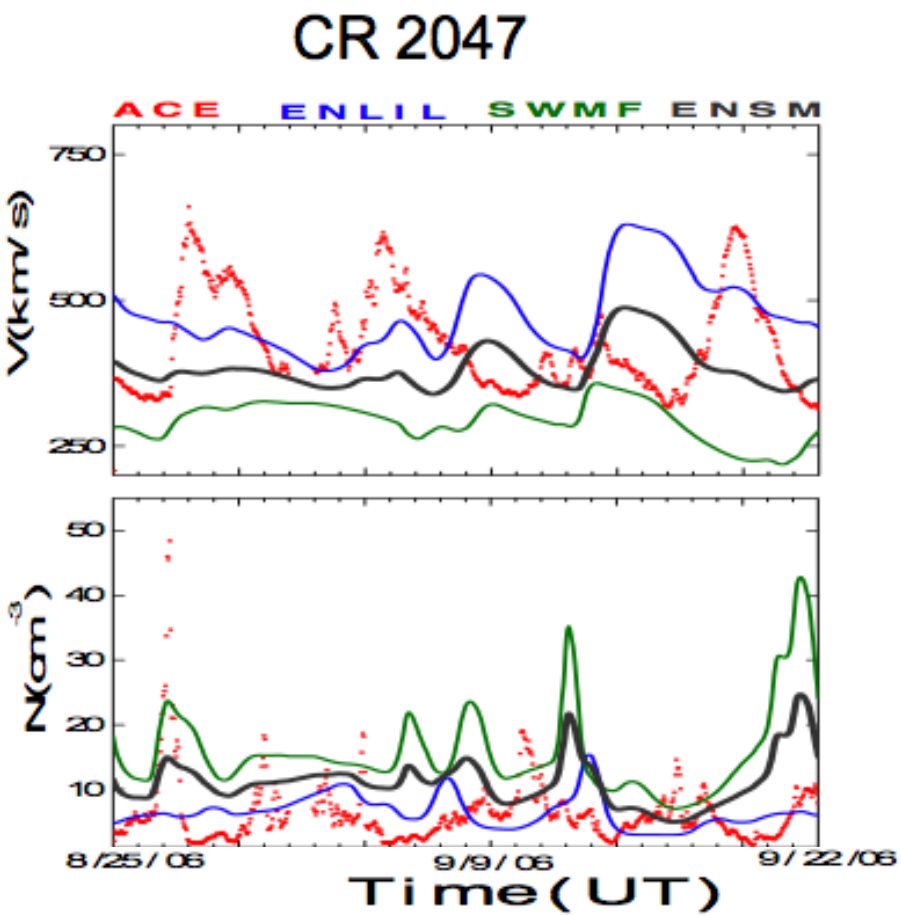
M. Maddox

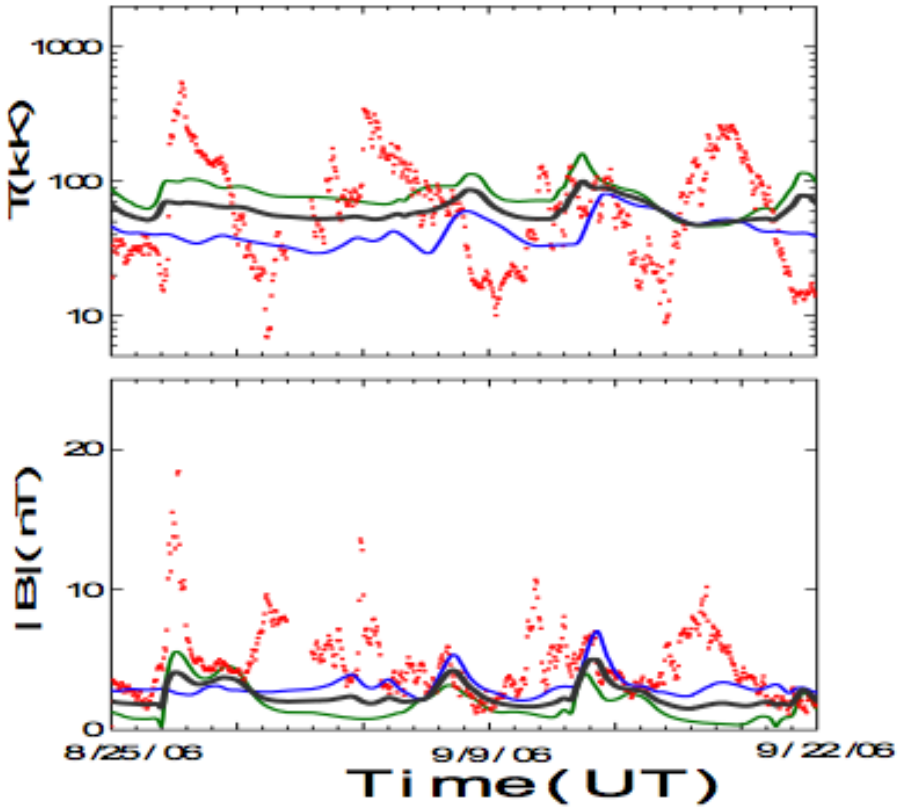
Rapid Transitioning Project with AFRL/SMC



Tech demo: RT auroral boundaries (~45min forecast, 4min updates) into AFRL auroral clutter product, facilitated by SMC

Future Options: Ensemble Modeling





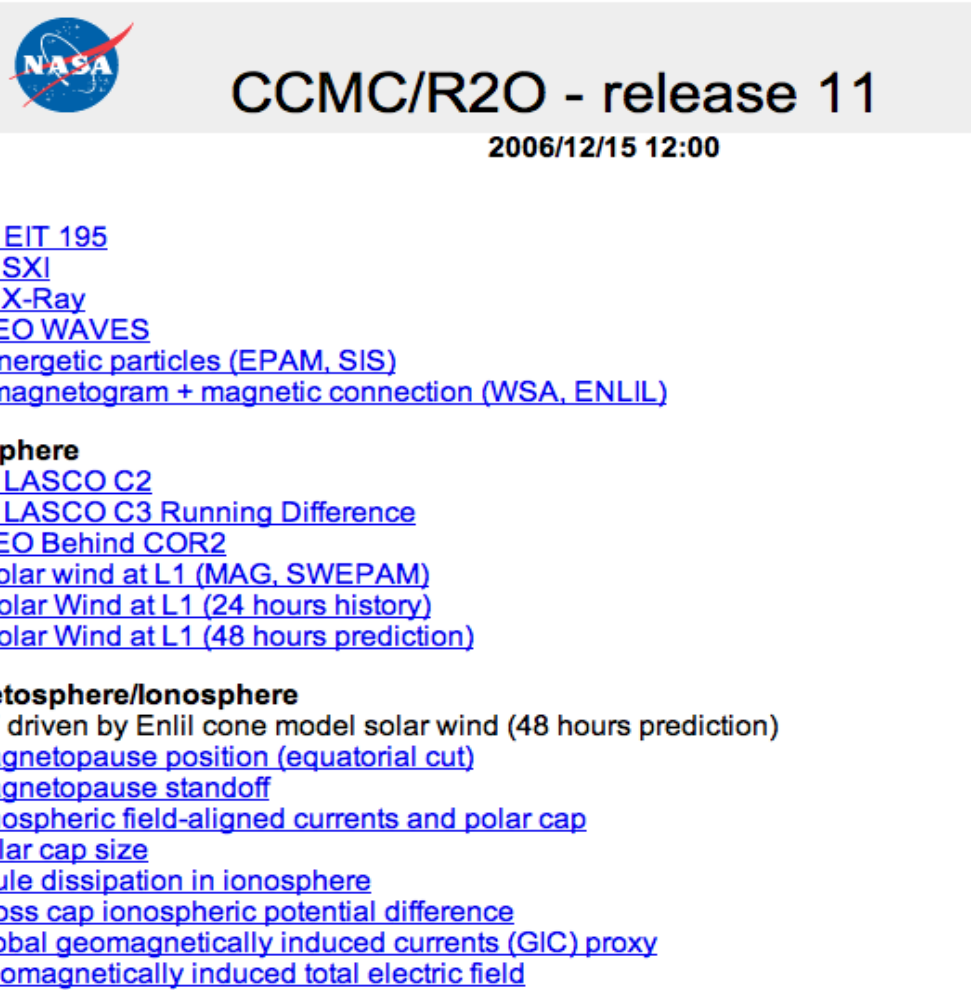
Model: WSA/ENLIL (CISM), SWMF (CSEM)

R2O workshop (October 2007)

Tool for Space Weather Architecture Planning

- http://ccmc.gsfc.nasa.gov/R2O

- Expose models to operators
- Identify forecast products
- Identify optimal display
- Forum for feedback
- Future workshop in planning phase



CCMC/R2O - release 11

2006/12/15 12:00

Solar
SOHO EIT 195
GOES SXI
GOES X-Ray
STEREO WAVES
ACE energetic particles (EPAM, SIS)
Solar magnetogram + magnetic connection (WSA, ENLIL)

Heliosphere
SOHO LASCO C2
SOHO LASCO C3 Running Difference
STEREO Behind COR2
ACE solar wind at L1 (MAG, SWEPAM)
Enlil Solar Wind at L1 (24 hours history)
Enlil Solar Wind at L1 (48 hours prediction)

Magnetosphere/Ionosphere
SWMF driven by Enlil cone model solar wind (48 hours prediction)
- Magnetopause position (equatorial cut)
- Magnetopause standoff
- Ionospheric field-aligned currents and polar cap
- Polar cap size
- Joule dissipation in ionosphere
- Cross cap ionospheric potential difference
- Global geomagnetically induced currents (GIC) proxy
- Geomagnetically induced total electric field

Future of CCMC Space Weather Forecasting Support

- Provide tool by which science progress at NASA, NSF, AFOSR, ONR… feeds into Space Weather operations
- CCMC models, data streams available to support NASA, USAF, NOAA SWx
  - Models fill (large) data gaps, provide situational awareness
  - Model output tailored to operator needs
  - Quasi-operational model results/forecasts already existing
  - Unique services
- Pursue emerging partnerships with commercial entities (EPRI, SET..)
- Partnerships CCMC-AFRL-NRL to facilitate rapid transition to AFWA operation
  - CCMC has unique experience in RT modeling
  - CCMC has trusted relation with model owners

- Other activities
  - Education: Working with AFIT, USAFA, many Universities

CCMC ready to support Space Weather Forecasters