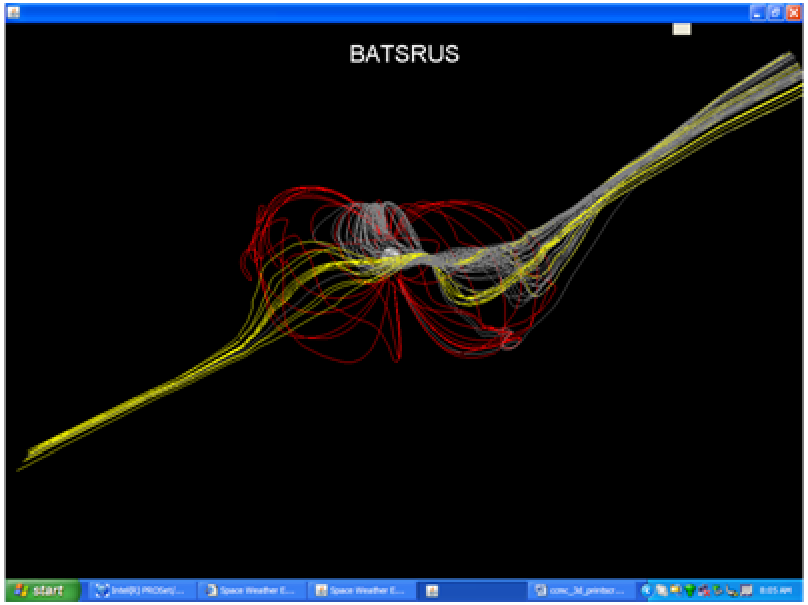
Session Summaries

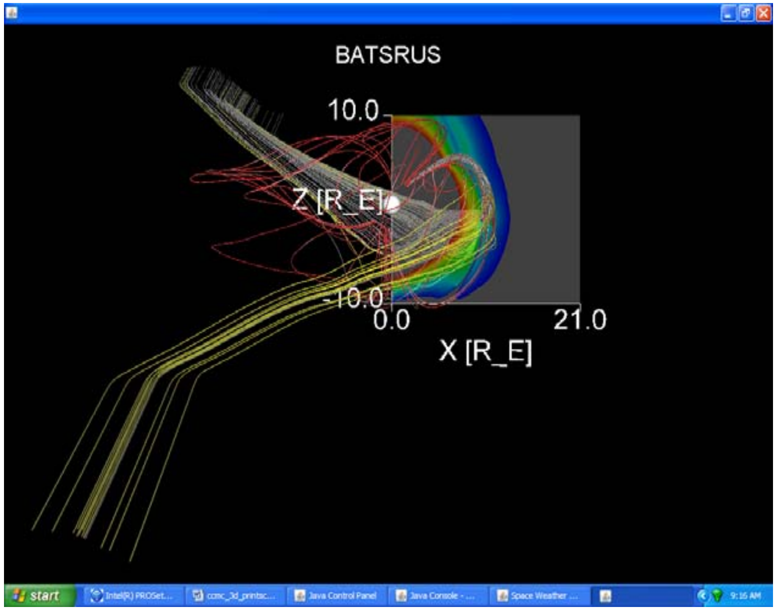
- User Feedback
  - S. Erriksson
  - D. Rees
  - T. Falkenberg
  - J. Borovsky
- CCMC Education and Outreach
  - R. Walker
  - D. Knipp
  - G. Siscoe, M. Kuznetsova, A. Chulaki

Stefan Eriksson: THEMIS Support

- Showed interaction of CCMC modeling and visualization capabilities with analysis of a THEMIS FTE observation
- Space Weather Explorer played a prominent part:
  - Discovering topology
  - Virtual satellite

Visualization examples

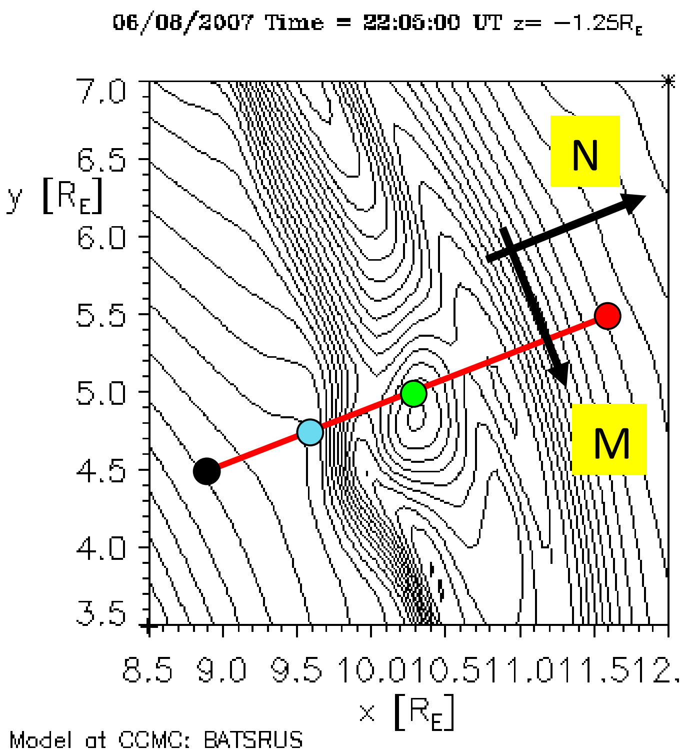


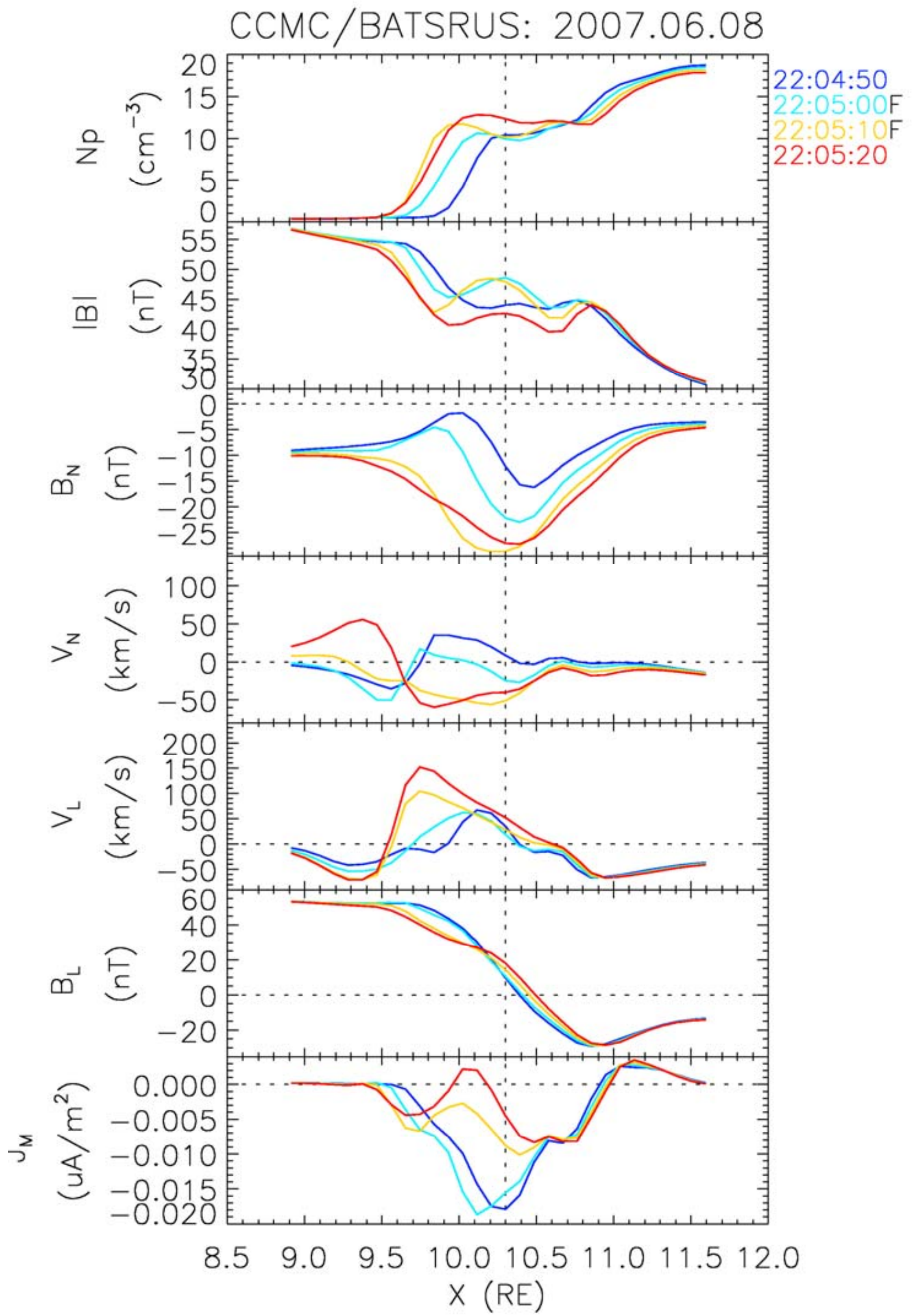


CCMC time series profiles from all 30 "probes":

Central probe at (X,Y)=(10.3,5.0) indicated by vertical line.

Times when FTE is closest to central probe at this (X,Y) are indicated by "F".





David Rees: Ionosphere Models

- Bit of different thrust: not observational analysis but mission planning
- Example of SWARM requirements
  - Magnetic field from MI currents bigger than the signal they want to get to.

	Requirement (1σ)	Predicted Performance #	Numerical Simulation Results
Scalar magnetic field down to 20 km scales	Random: 0.15 nT	0.13 nT	0.11 nT
	Stablity: 0.05 nT per 3 months	compliant	n.a.
Vector magnetic field down to 2 km scales	Random: 0.5 nT	0.49 nT*	[0.245, 0.155, 0.22] nT
	Stability: 0.5 nT per year	0.49 nT	n.a.
Vector electric field down to 20 km scales	Random: 1.5mV/m	1.35 m V/m**	[0.22, 0.345, 0.20] mV/m
	Stability 0.5 mV/m per month	compliant	n.a.
Electron density down to 20 km scales	$0.5 \cdot 10^{10}\ m^{-3}$ RMS precision	compliant	$0.6 \cdot 10^{10}\ m^{-3}$ RMS***
Air drag down to 200 km scales	Random $2.5 \cdot 10^{-8}\ m\ s^{-2}$	$1.5 \cdot 10^{-8}\ m\ s^{-2}$	$[0.9, 1.6, 1.85] \cdot 10^{-8} m\ s^{-2}$

In the case of a vector, one value is given that is representative for each of the three components.

* *Predicted value from analytic assessment is higher because this also includes the expected calibration errors. The latter are considered realistic because they are based upon what is currently possible for single-satellite missions like Ørsted and CHAMP.*

** *Predicted value from the analytical assessment is higher because it includes worst-case values for effects that were not included in the simulator (Technical and Programmatic Annex).*

*** *Results based on a simplified model (Technical and Programmatic Annex).*

Thea Falkenberg: Solar/Helio Models

- Walked us through how actually to set up runs for ENLIL /code model and use the output data
- Detailed suggestions for improvement of user experience

Suggestions for improvements

- Time resolution in plotting interface is very low
  - Increase or make an option to increase
- Longitude input parameter
  - Which is East/West
- Cloud density and temperature
  - Value or both factor and value
  - Factor does not have to be integer
- Remove ”fast solar wind” values or make them more transparent
- Remove ”shape” option (as long as its not implemented)
- Add option to upload orbit of i.e., Spacecraft to get out put at that location (like the planetary ascii files)
  - Maybe automatic (or tick box) output at STEREO, Messenger....
- Field line tracing, field line data available
- Remove irrelevant ’description columns’
- WSA version number in control file
- Make clear what parameters are open for variation for experienced users (i.e., gamma...)

Joe Borovsky: Magnetosphere Models

- Using CCMC model (BATS’R’US) to test specific physical picture of dayside reconnection
- Required CCMC to help with code modifications
- Developers are
  - A. uninterested
  - B. too busy
  - C. want money
  - D. all of the above
- Should CCMC do more of this sort of work?

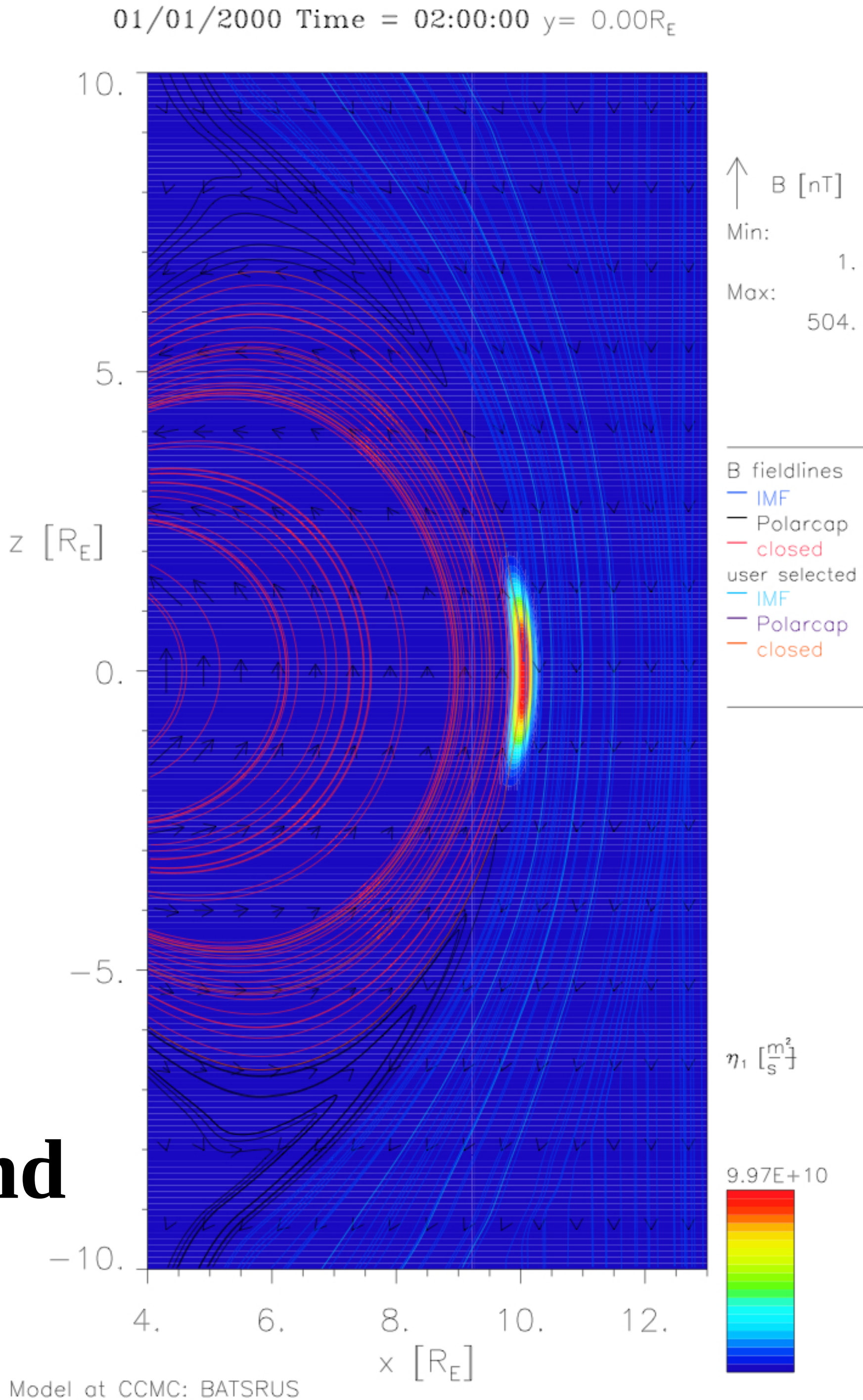
Dayside Reconnection Simulations

BATSRUS code at CCMC

Use high-resolution dayside grid (1/16 R_E).

Using resistive spot across dayside magetopause.

Run large range of solar-wind parameters.



Testing the "Reconnection Control Function"

Correlation coefficients for the 1963-2003 OMNI2 data set (158,000 hours of data).

	AE_1	AU_1	AL_1	PCI_{thule}	MBI_1	Kp
Akasofu ε = $vB^2 \sin^4(\theta/2)$	0.52	0.39	0.52	0.52	0.49	0.47
Electric Field = $-E_y$	0.68	0.51	0.67	0.65	0.61	0.52
$vB_\perp \sin^2(\theta/2)$	0.69	0.56	0.67	0.70	0.66	0.60
Newell Function = $v^{4/3} B_\perp^{2/3} \sin^{8/3}(\theta/2)$	0.76	0.60	0.74	0.75	0.72	0.63
Recon. Control Function	0.75	0.62	0.72	0.73	0.74	0.68

Discussion Items

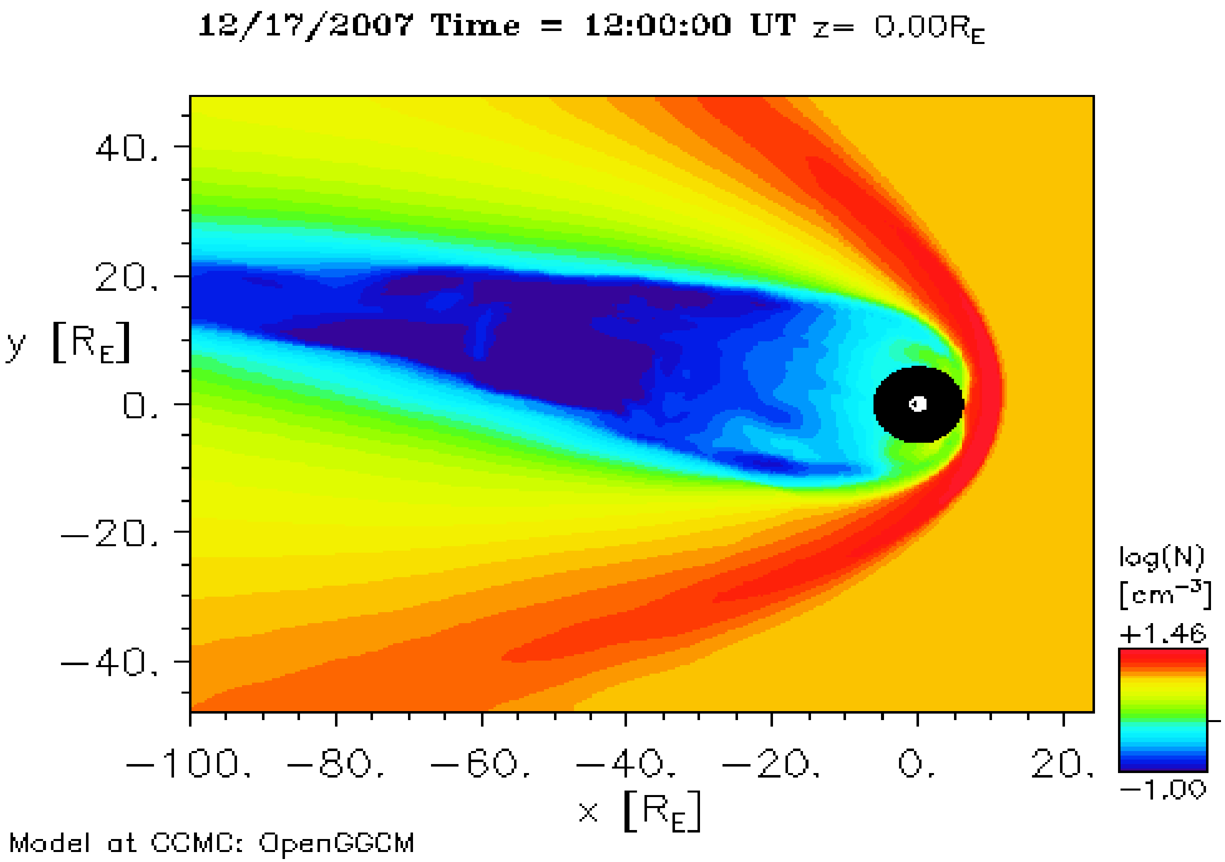
- Better identification of model outputs – in particular run ID on plots
- Color table selection for plots
- Space Weather Explorer and Kameleon are great tools:
  - Need to bring more models into framework

Ray Walker: Science and Education Opportunities at CCMC

- Use of CCMC models to show physical processes and visualize complex structures
- How to use CCMC models to give non-developers an idea of strengths and limitations
- Walk through of a course to familiarize students with simualtions and how they fit together

Demonstrating a Basic Idea - Courtesy of Martin Connors

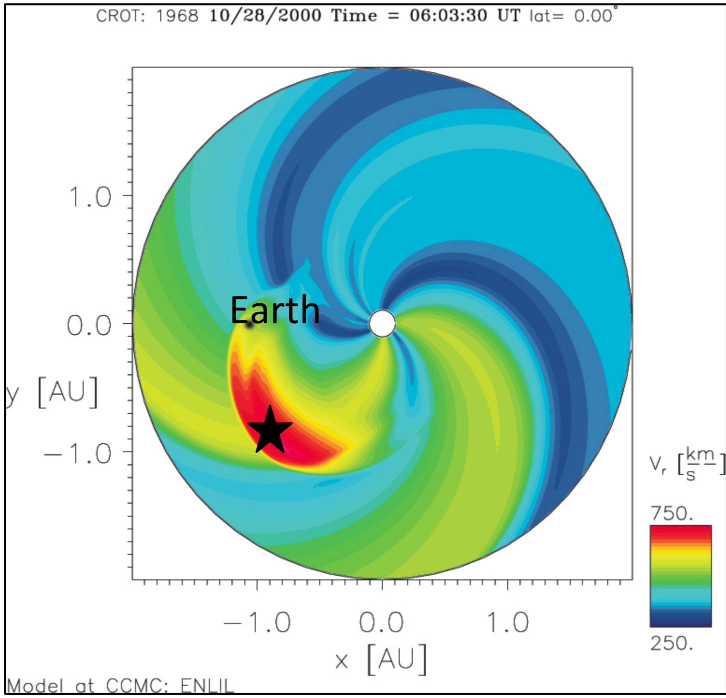
Compression at the Bow Shock



The supersonic solar wind compresses the front side of the magnetosphere and shocked compressed solar wind forms the *magnetosheath*. *Inside* the magnetosphere, the magnetic field dominates and density is low.

What the Students Did

- Studied Halo CME on October 25, 2000
- Used three simulation codes
  - ENLIL with cone model
  - BATS-R-US model using ENLIL with cone model results as input
  - BATS-R-US model using ACE observations as input
  - Ran BATS-R-US with Fok model ring current
  - Ran BATS-R-US with Rice Convection Model



Dolores Knipp: Using CCMC in Education at the University of Colorado

- **CU Aerospace Environment Course**
  - **Technically savvy, novice students**
  - **Very engaged provided with right motivation**
- **CCMC Model Web Provides Access to**
  - **Static Models**
    - **Reinforce basic physics, Specify climatology**
    - **order of magnitude values, units ,etc**
    - **Model outputs need to be manipulated by students to do homework**
- **CCMC Runs on Request (in development)**

  Visualize time varying, complex, 3-D systems

  Verification and Validation Projects

AE8MAX / AP8MAX

Model: **AE8MAX** , Energy values: 2,3 L-values: 6.6 B/B0 values: 1

Output fluxes: **Differential** **Results of MODEL calculations:**

differential flux [ELECTRONS/cm*cm*sec*MeV]

```
 L  \\ E/MeV   2.00     3.00     0.00     0.00     0.00     0.00   B/B0=    1.00
------\\-------------------------------------------------------------
   6.60 I       3.62E+04  0.00E+00  0.00E+00  0.00E+00  0.00E+00
-------------------- flux values below 10 are not reliable -----------
```

Multiply differential flux by 86500 s (in one day)

$(3.62x10^4\ e^-/cm^2/s/Mev)$ *(86500 s)*1 Mev = $\underline{3.13x10^9\ e^-/cm^2}$

****

Model: **AP8MAX** Energy values: 2, 3 L-values: 6.6 B/B0 values: 1

Output fluxes: **Differential** **Results of MODEL calculations:**

differential flux [PROTONS /cm*cm*sec*MeV]

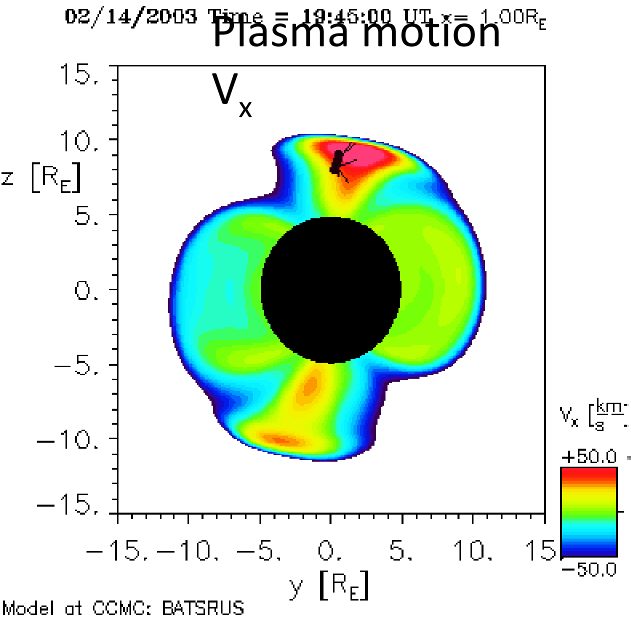
```
L \\ E/MeV 2.00    3.00    0.00     0.00     0.00      0.00              B/B0= 1.00
-6.60 I         0.00E+00   0.00E+00   0.00E+00   0.00E+00   0.00E+00
-------------------- flux values below 10 are not reliable -----------
```

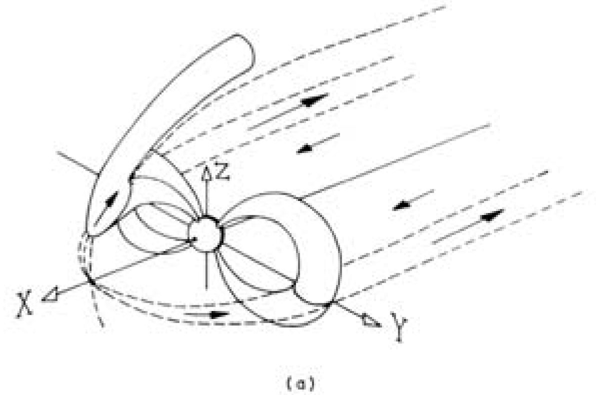
Multiply differential flux by 86500 s (in one day)

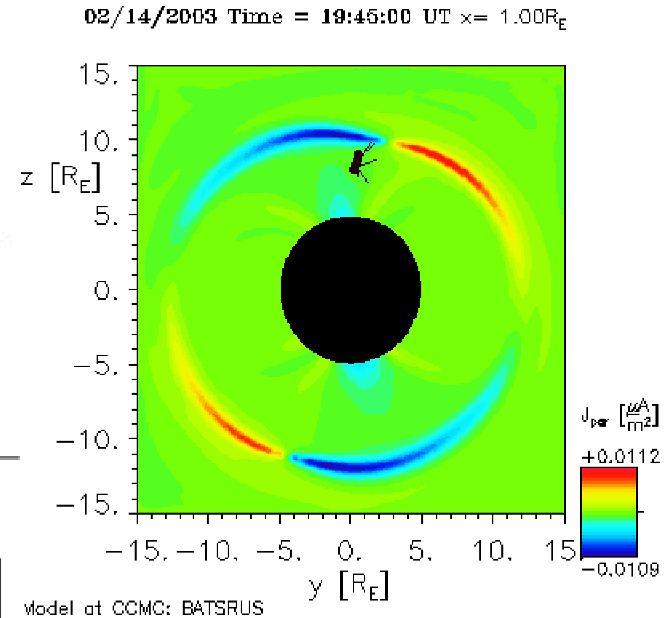
(0 protons/cm^2/s/Mev) *(86500 s)*1 Mev = $\underline{0\ protons/cm^2}$

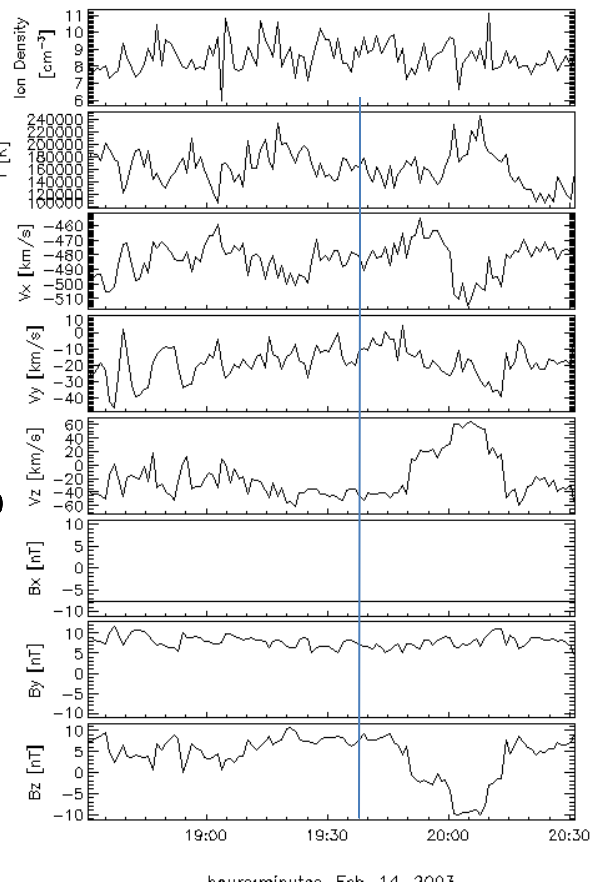
Plasma motion

V_x









(ACE; at upstream boundary of simulation, no delays)

Vx plots at the X=1 RE YZ plane.

The IMF Bz is northward for this event with the exception for a shorter period of southward IMF.

The southward turning occurred just after 1950 UT and at ~2000 UT IMF Bz gets even stronger southward.

The Bz turns northward again during 2010-2015 UT.

-There is a clear sunward Vx flow in both polar cap regions (lobe reconnection in both hemispheres) 1945-2000 UT.
-During 2005-2010 UT there is no flow (Vx=0) in the polar cap.
-During 2015-2020 UT, Vx is tailward over the caps as expected for southward Bz.
-At 2025 UT, a separate sunward flow channel becomes evident near the duskside flank that reaches toward the northern polar cap.
-At 2030 UT, this flow channel has migrated further poleward.

Siscoe et al.: On-Line Education Material DEMO

- Web based modules as a “course” in space physics
  - Demo of unmagnetized solar wind
- Discussion
  - Physics is good, but
    - Too fast
    - No check on student comprehension
    - What’s the target audience?
  - Volunteers to try it out at home institutions

Discussion items

- CCMC is a great resource, but don’t want to keep reinventing the wheel
  - Repository for course materials, summer schools, etc.
  - Repository for useful images and movies