On-Line Visualization

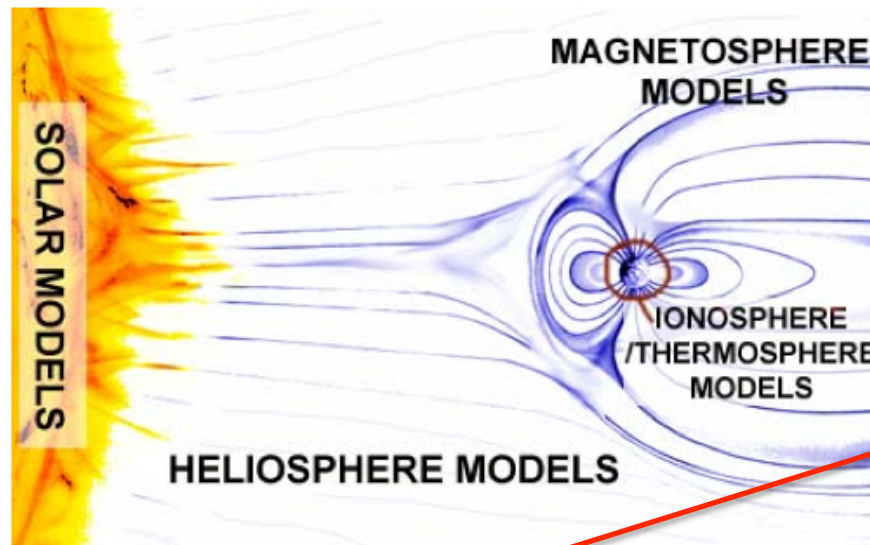## Quiet Magnetosphere

Heliophysics Laboratory Primer
Quiet Magnetosphere

Heliophysics Laboratory Primer

This primer has been created to help you to:

1. use the CCMC tools designed to interrogate Heliophysics models at CCMC, and
2. obtain a top level view of the connectivity and naming of regions and parameters that comprize the heliophysics system.

The heighest level picture of the Heliophysics system shows three components - the Sun, the solar wind, and the magnetosphere while buried inside the magnetosphere is the ionosphere and thermosphere. Click for the specific primer:

Click here

- Heliosphere
- Magnetosphere
- Ionosphere/Thermosphere

On-line Visualization
Quite Magnetosphere (Equinox)

Click here

Magnetosphere

Quiet magnetosphere (Equinox)

Run Number	Keyword	Model	Model Version	Event date	V_x	N	|B|	IMF Clock Angle	B_x	B_y	B_z	Conductance Model
HSS2011_SWMF_051111_2	HS2010, equinox, quiet	BATSRUS	v8.01	March 21 2007	-400.0	5.0	5.0	180.0	0.0	0.0	-5.0	uniform p=5,h=0

Run output in CDF format: HSS2011_SWMF_051111_2_T200.out.cdf

Magnetosphere Tutorial

Space Weather Explorer Tutorial

On-Line Visualization: Quiet Magnetosphere

HSS2011_SWMF_051111_2

Title/Introduction:

Key Word: HS2010, equinox, quiet

3D MHD Model: BATSRUS
Simulation With Modeled Conditions
Inflow Boundary Conditions: Fixed
Start Time: 2000/01/01 00:00
End Time: 2000/01/01 02:00
Dipole Tilt at Start in X-Z Plane: 0.0 deg.
Dipole Tilt in Y-Z GSE Plane: 0.0 deg.
Dipole Update With Time: no
Ionospheric Conductance: uniformp5,h0
No Corotation Velocity is Applied at The Inner Boundary.
Radio Flux 10.7 cm: 150.
Coordinate System for the Output: GSM
Initial Solar Wind (SW) Parameters in GSM Coordinates:

  SW Density: 5.00 n/cc
  SW Temperature [Kelvin]: 232100.00 Kelvin
  X Component of SW Velocity: -400.00 km/sec
  Y Component of SW Velocity: 0.00 km/sec
  Z Component of SW Velocity: 0.00 km/sec
  IMF Bx: 0.00 nT
  IMF By: 0.00 nT
  IMF Bz: -5.00 nT
  IMF |B|: 5.00 nT
  IMF Clock Angle: 180.0 deg.

- View solar wind input data
- List solar wind input data in ASCII format (see format description here).
- View Magnetosphere
- Create Timeseries in Magnetosphere
- View Ionosphere
- View Northern hemisphere polar cap flux and area
- View Southern hemisphere polar cap flux and area
- View Magnetopause standoff and closest approach within 30 deg. of Sun-Earth line (local noon)
- View Polar cap boundary at 24 magnetic local times
- View Ionospheric dissipation Ring Current data:
- View Ring Current H+ ion data
- View Ring Current electron data

Click here

Make a First Plot with Default Selections

Click here

**3D Simulation Results: Model: BATSRUS
Run: HSS2011_SWMF_051111_2**

This is the web interface for the visualization of results of a three-dimensional simulation of the Earth's environment.

Please review the **default selections** below and make your changes.

To start the graphics program click the *Update Plot* button. The resulting image will be displayed at this location of the page.

Should the result be a black image, then the graphics program encountered a programming error. Please report the set of input parameters used.

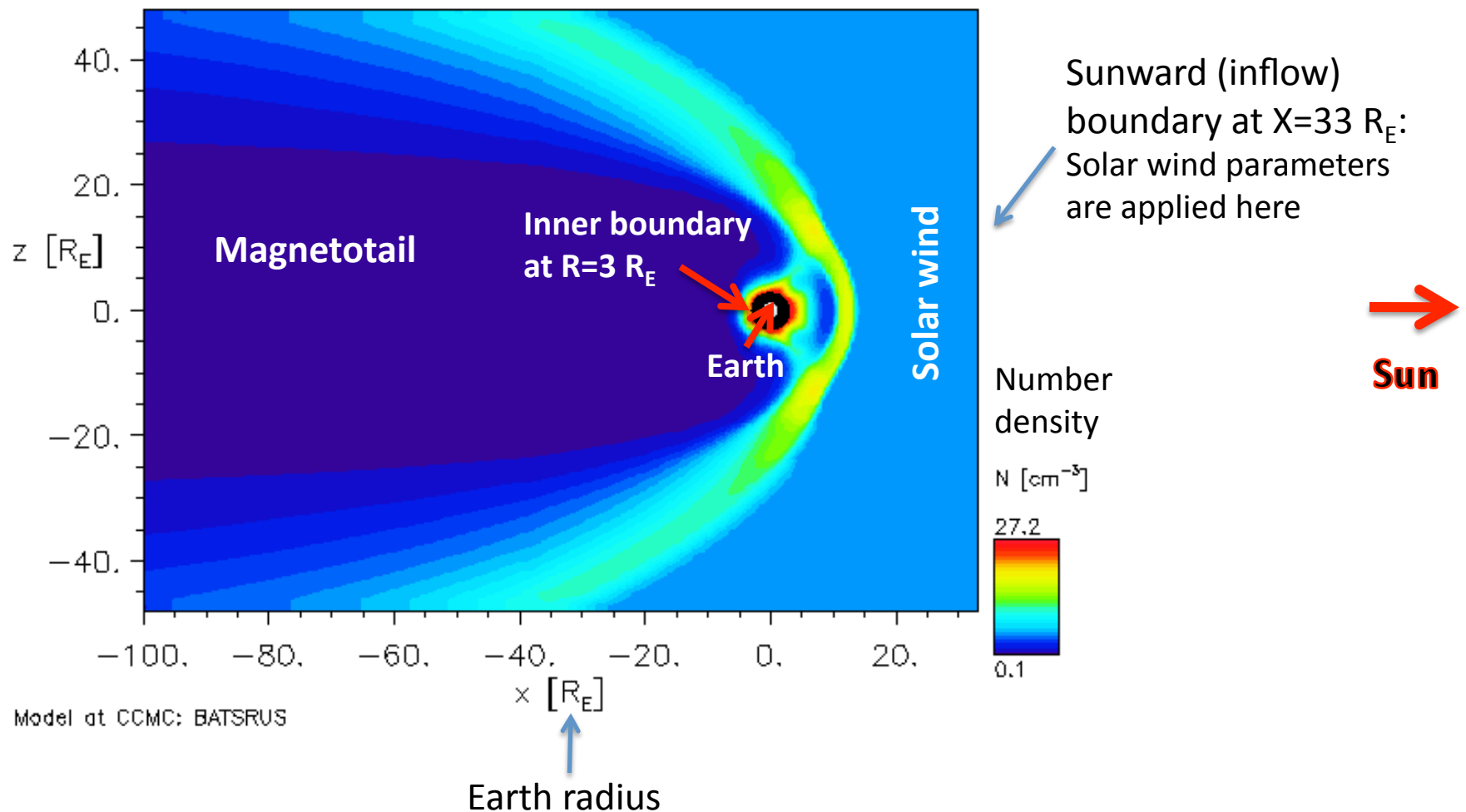Go back to web page of run

(Update Plot)   *Update Plot* will update (generate) the plot with the chosen time and plot parameters below. **This will take some time (typically 10-30s) as data is read in and processed.**

Magnetosphere Overview Plot: Color Contour
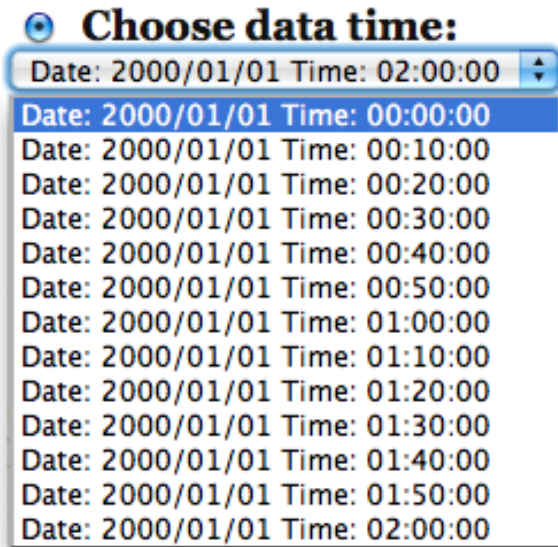## Number density in noon-midnight meridianal plane (Y=0)

Default date for runs with model conditions

01/01/2000 Time = 02:00:00 UT y= 0.00R_E

Sunward (inflow) boundary at X=33 R_E: Solar wind parameters are applied here

Magnetotail

Inner boundary at R=3 R_E

Earth

Solar wind

Sun

Number density

N [cm^{-3}]

27.2

0.1

Model at CCMC: BATSRUS

z [R_E]

x [R_E]

Earth radius

Select time step

Choose data time:

Date: 2000/01/01 Time: 02:00:00

Date: 2000/01/01 Time: 00:00:00
Date: 2000/01/01 Time: 00:10:00
Date: 2000/01/01 Time: 00:20:00
Date: 2000/01/01 Time: 00:30:00
Date: 2000/01/01 Time: 00:40:00
Date: 2000/01/01 Time: 00:50:00
Date: 2000/01/01 Time: 01:00:00
Date: 2000/01/01 Time: 01:10:00
Date: 2000/01/01 Time: 01:20:00
Date: 2000/01/01 Time: 01:30:00
Date: 2000/01/01 Time: 01:40:00
Date: 2000/01/01 Time: 01:50:00
Date: 2000/01/01 Time: 02:00:00

Choose time step from the pull-down menu

Click "**Update Plot**" to make a plot with default selections

OR

Scroll down to modify default selections such as "Physical Variables", "Plot Mode", "Plot Area", "Plot Options", etc.

Select Plot Mode and Physical Variables to be Displayed from Pull-Down Menus

Click here for Plot Modes description

Click here for the complete list of physical variables written by global MHD models

Choose **quantity** to be displayed (some **Plot Modes** require up to three choices):

Q 1: [J] Q 2: [N] Q 3: [N]

Note [ ], gradients and curls are not yet available with SWX plot mode

Choose **Plot Mode:**
[ColorContour (2D)]

- 3D–Surface
- Line (1D)
- Contour (2D)
- Vector (2D)
- ColorContour (2D)
- Color+Vector
- Contour+Vector
- Color+Contour
- Color+Vector+Contour
- Color+Vector+Flowlines
- 3D Flowlines

Q1 dropdown list:
- N
- V_x
- V_y
- V_z
- B_x
- B_y
- B_z
- P
- B1_x
- B1_y
- B1_z
- En.
- J_x
- J_y
- J_z
- B
- beta
- V
- J
- B1

elected ...les:

..lines:

Color Contour, (Vertical) Li...
- Color table: [Rainbow]
- ☐ Reverse Colortable
- Number of levels: [32]

Plot Mode Example:

ColorContour – Contour plot in 2D slice (2D Plot Area) using color-filled levels. Physical Variable (e.g., J – current density magnitude) is selected in Q1 pull-down menu

Scroll down to choose "Plot Area"

Choose Plot Area

Choose Plot Area:

All **Plot Modes** except **Line Plot** and **Vertical Plot**: Select lower left corner of plot area on the left, and the upper right corner on the right.

Line Plot: Select start point of line on the left, the end point on the right.

~~**Vertical Plot:** Select X and Y position~~ on the left.

			Choose Cut Plane:	
X_1 [-30]	X_2 [15]	Range: -255 ... 33 R_E	X=constant ⊙	[-15]
Y_1 [-21]	Y_2 [21]	Range: -48 ... 48 R_E	Y=constant ○	[0]
Z_1 [-15]	Z_2 [15]	Range: -48 ... 48 R_E	Z=constant ○	[0]

[Reset Form] *Reset Form* will reset changes to the defaults specified by the previous run of this script.

[Update Plot] *Update Plot* will update (generate) the plot with the chosen time and plot parameters above.

Choose Cut Plane, e.g.,
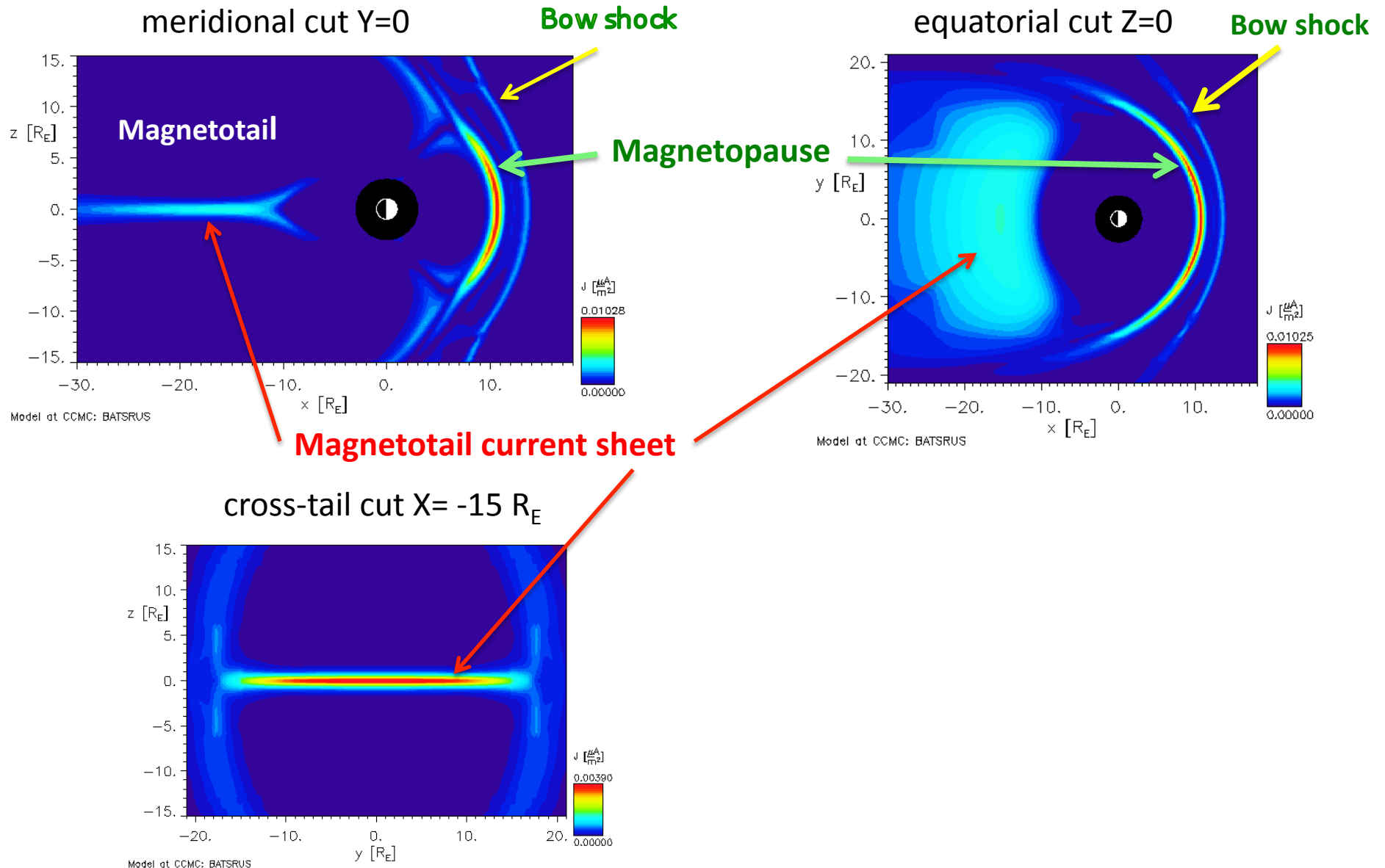
    Y = 0 – noon-midnight meridional plane
    Z = 0 – equatorial plane
    X = -15 R_E – cross-tail cut

Choose Plot Area: Zoom-in to the area of interest

Click "Update Plot"

Color Contour Plots of Current Density (J) in Different Cut Planes

meridional cut Y=0

Bow shock

Magnetotail

Magnetopause

Magnetotail current sheet

equatorial cut Z=0

Bow shock

cross-tail cut X= -15 R$_E$

Example: Color+Vector+Flowlines Plot Mode
Plasma Pressure, Velocity Vectors, Magnetic Field Lines

Choose Plot Mode: **Color+Vector+Flowlines**
Choose Physical Variable for Color (Q1 menu): **P (pressure)**
Choose Physical Variable for Vector (Q2 menu): **any component of the velocity vector (V_x, V_y or V_z)**
Choose Physical Variable for Flowlines (Q3 menu): **any component of the magnetic field vector (B_x, B_y or B_z)**
Choose Cut Plane: **Y=constant=0**
Choose Plot Area: **X_1=-25, X_2=15, Z_1=-15, Z_2=15**

(Update Plot) *Update Plot* will update (generate) the plot with the chosen time and plot parameters below. **This will take some time (typically 10-30s) as data is read in and processed.**

Modify Plot Options
Set flow lines thickness to 3

Plot Options:
☑ **Exclude region around the Earth** up to [3] R_E

◉ **Choose data time:**
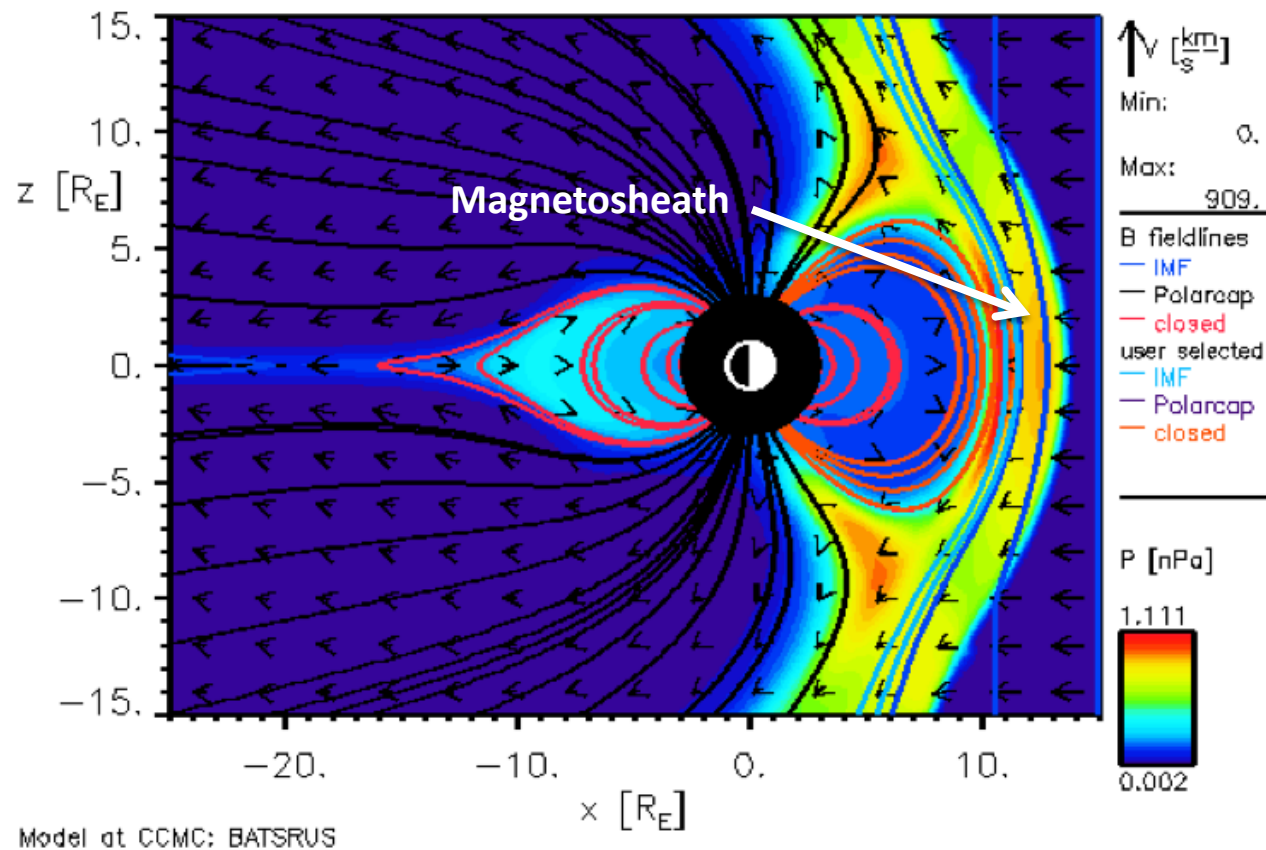[Date: 2000/01/01 Time: 02:00:00 ◆]

Image magnification [1 ◆]
(all images; use >=1.25 for 3D Flowlines)
Line thickness [3 ◆] (flow lines, arrows)

Click "Update Plot"

Example: Color+Vector+Flowlines Plot Mode (Results)
Plasma Pressure, Velocity Vectors, Magnetic Field Lines,

Red lines (closed): Magnetic field (MF) lines with both ends connected to the Earth
Black lines (open): MF lines with only one end a the Earth
Blue lines (interplanetary): MF lines with both ends in the interplanetary space

Example: Color+Vector+Flowlines Plot Mode
V_x Velocity Component, Velocity Vectors, Velocity Flowlines

Choose Plot Mode: **Color+Vector+Flowlines**
Choose Physical Variable for Color (Q1 menu): **V_x (X-component of velocity)**
Choose Physical Variable for Vector (Q2 menu): **any component of the velocity vector (V_x, V_y or V_z)**
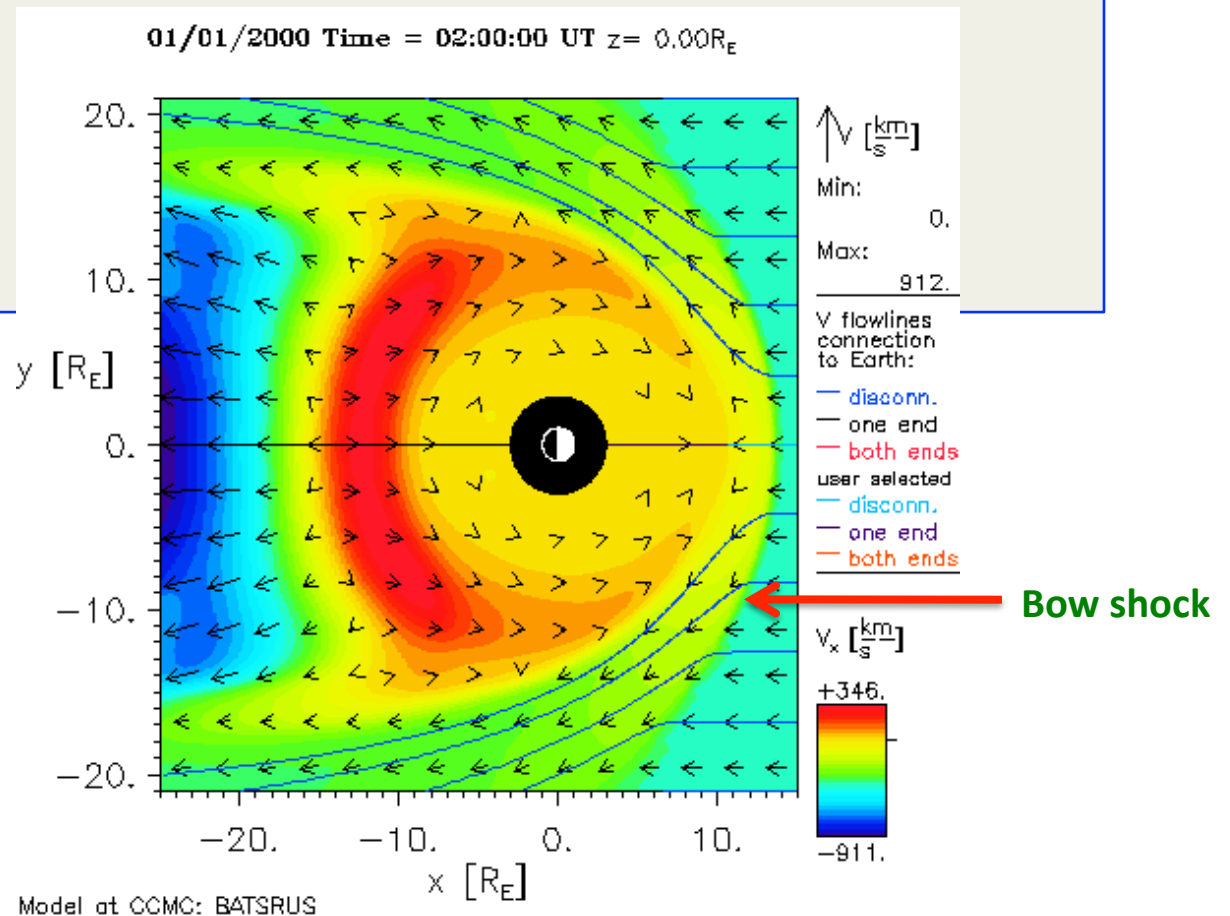Choose Physical Variable for Flowlines (Q3 menu): **any component of the velocity vector (V_x, V_y or V_z)**
Choose Cut Plane: **Z=0**
Choose Plot Area:
X_1=-25, X_2=15, Y_1=-21, Y_2=21

Click "Update Plot"

Bow shock

Example: Line (1D) Plot Mode
Velocity, Current Density, and Number Density

Choose Plot Mode: **Line (1D)**
Choose 1st Physical Variable (Q1 menu): **V (velocity)**
Choose 2nd Physical Variable (Q2 menu): **J (current density)**
Choose 3rd Physical Variable (Q3 menu): **N (number density)**

Choose **quantity** to be displayed (some **Plot Modes** require up to three choices):

Choose **Plot Mode:**
Line (1D)

Q 1: [V] Q 2: [J] Q 3: [N]

Note: divergences, gradients and curls are not yet available with SWX plot modes.

Choose Cut Plane: **Z=0**
Choose start point of line: **X_1=7, Y_1=0, Z_1=0**
Choose start point of line: **X_2=14, Y_2=0, Z_2=0**

X_1 [7] X_2 [14]   Range: -255 ... 33 R_E
Y_1 [0] Y_2 [0]   Range: -48 ... 48 R_E
Z_1 [0] Z_2 [0]   Range: -48 ... 48 R_E

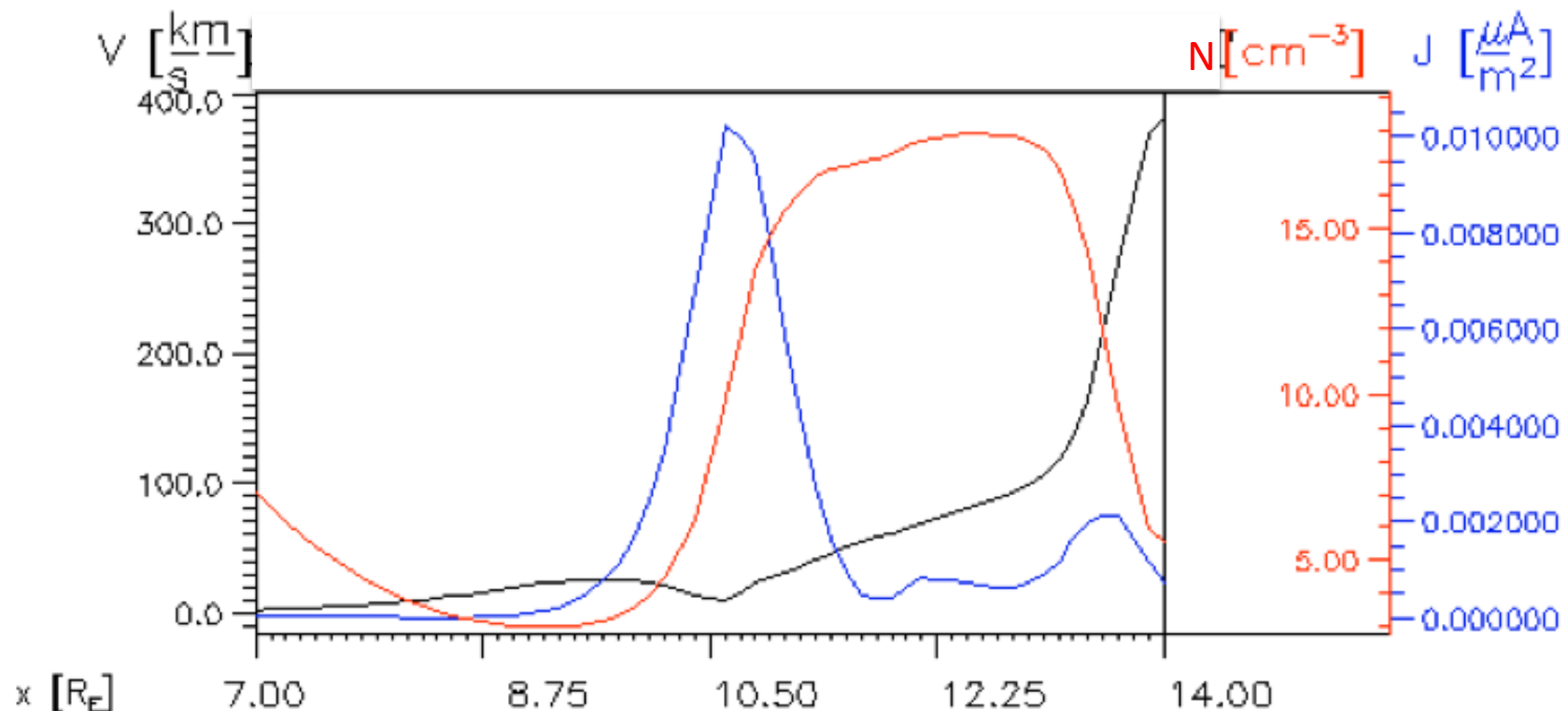Click "Update Plot"

Example: Line (1D) Plot Mode (Results)
Velocity, Current Density, Number Density

Choose Plot Mode: Line (1D)
Choose 1st Physical Variable (Q1 menu): **V (velocity)**
Choose 2nd Physical Variable (Q2 menu): J (current density)
Choose 3rd Physical Variable (Q3 menu): N (number density)

Go Back to the Web Page of the Run

Model: BATSRUS
Run: HSS2011_SWMF_051111_2

To track usage for our government sponsors, we ask that you notify CCMC staff whenever you use CCMC results in a scientific publication or presentation. Thank you.
Go back to web page of run

Click here

Visualize Ionosphere Electrodynamics (optional)

HSS2011_SWMF_051111_2

Title/Introduction:

Key Word: HS2010, equinox, quiet

3D MHD Model: BATSRUS
Simulation With Modeled Conditions
Inflow Boundary Conditions: Fixed
Start Time: 2000/01/01 00:00
End Time: 2000/01/01 02:00
Dipole Tilt at Start in X-Z Plane: 0.0 deg.
Dipole Tilt in Y-Z GSE Plane: 0.0 deg.
Dipole Update With Time: no
Ionospheric Conductance: uniformp5,h0
No Corotation Velocity is Applied at The Inner Boundary.
Radio Flux 10.7 cm: 150.
Coordinate System for the Output: GSM
Initial Solar Wind (SW) Parameters in GSM Coordinates:

SW Density: 5.00 n/cc
SW Temperature [Kelvin]: 232100.00 Kelvin
X Component of SW Velocity: -400.00 km/sec
Y Component of SW Velocity: 0.00 km/sec
Z Component of SW Velocity: 0.00 km/sec
IMF Bx: 0.00 nT
IMF By: 0.00 nT
IMF Bz: -5.00 nT
IMF |B|: 5.00 nT
IMF Clock Angle: 180.0 deg.

Field-aligned currents from the inner boundary of the magnetopshere domain (at about R = 3 R_E) are mapped along the magnetic field lines to the ionosphere (at about R=110 km). Ionosphere electrodynamics solver derives electrostatic potential at the R=110 km sphere and map it back to the magnetosphere

- View solar wind input data
- List solar wind input data in ASCII format (see format description here).
- View Magnetosphere
- Create Timeseries in Magnetosphere
- View Ionosphere
- View Northern hemisphere polar cap flux and area
- View Southern hemisphere polar cap flux and area
- View Magnetopause standoff and closest approach within 30 deg. of Sun-Earth line (local noon)
- View Polar cap boundary at 24 magnetic local times
- View Ionospheric dissipation Ring Current data:
- View Ring Current H+ ion data
- View Ring Current electron data

Click here

Make a Plot of Ionospheric Potential with Polar Cap (Default Selections)

Click here

2D Ionosphere output
Model: BATSRUS
Run: HSS2011_SWMF_051111_2

This is the web interface for the visualization of: Ionosphere of simulation of solar wind flow around the Earth.

Go back to web page of run
Please review the default selections below and make your changes.

To start the graphics program click the *Update Plot* button. The resulting image will be displayed at this location of the page.

Should the result be a black image, then the graphics program encountered a programming error. Please report the set of input parameters used.

(Update Plot) *Update Plot* will update (generate) the plot with the chosen time and plot parameters below. This will take some time (typically 5-10s) as data is read in and processed.

⊙ **Choose data time:**
[Date: 2000/01/01 Time: 02:00:00 ⬍]
- or -
○ **Change time** by moving
[-1] output steps
- or -
○ **Create GIF movie with current plot settings**
Note: This is a queue submission system requiring the following three additional inputs:

- **Start Time:**
  [Date: 2000/01/01 Time: 00:00:00 ⬍]

Plot Options:
View angles (latitude, longitude from local midnight for **EarthView** only):
   AX [-90..90]: [60]   AZ [0..360]: [0]
☐ **Plot in geographic coordinates with continents**
☐ **Show Grid** (in contour plots):
   ○ latitude-MLT/LT grid (10° in Theta, 30°
   ○ simulation grid
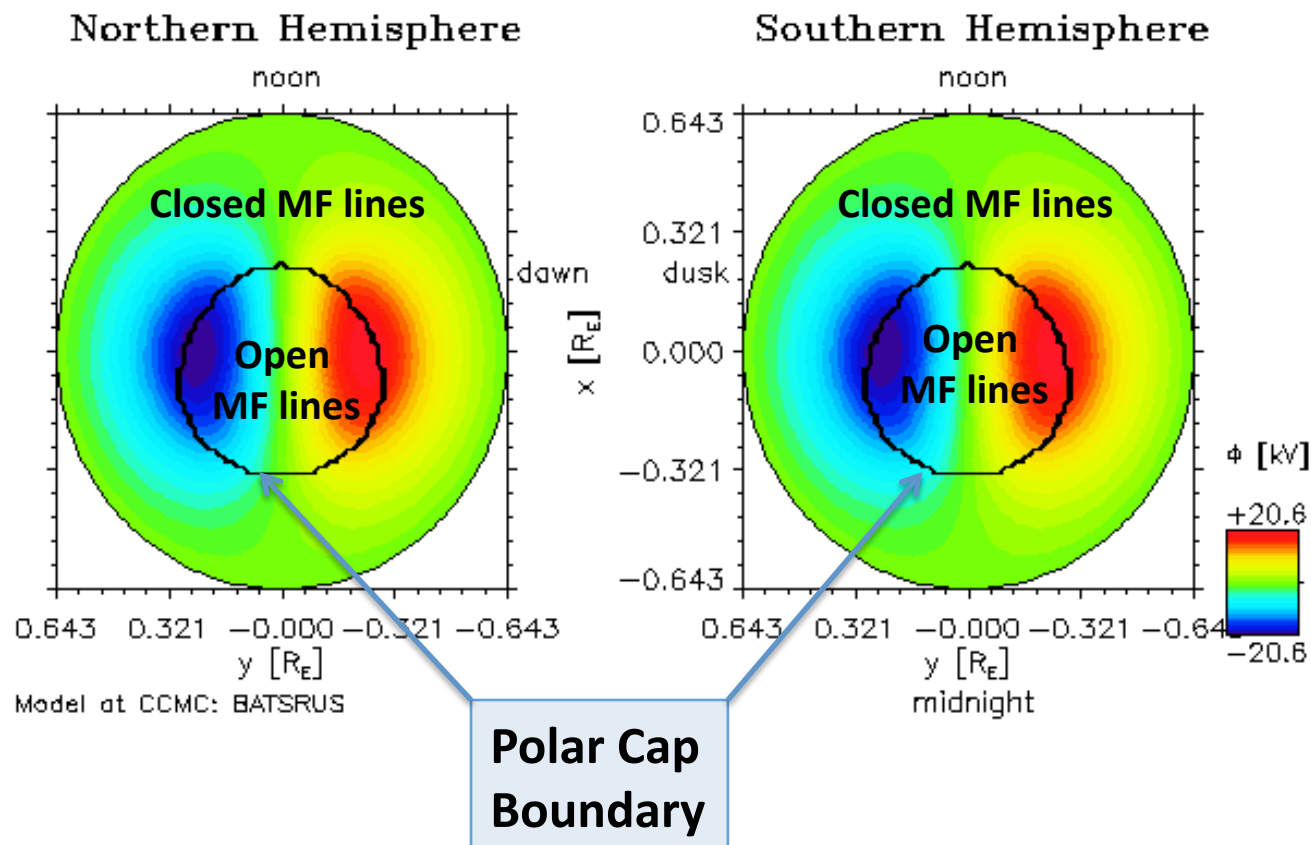**Image magnification** [1 ⬍] (all images)
Line thickness [1 ⬍] (flow lines, arrows)
Character thickness [1 ⬍] (all annotations)
☑ **Plot Polar Cap Boundary** (only runs where polar cap had been requested)

Check box

Ionospheric Potential with Polar Cap (Results)

Northern Hemisphere

Southern Hemisphere

noon

noon

Closed MF lines

Closed MF lines

Open MF lines

Open MF lines

dawn

dusk

0.643

0.321

0.000

−0.321

−0.643

$x\ [R_E]$

$\phi\ [kV]$

+20.6

−20.6

0.643 0.321 −0.000 −0.321 −0.643

$y\ [R_E]$

Model at CCMC: BATSRUS

0.643 0.321 −0.000 −0.321 −0.64

$y\ [R_E]$

midnight

Polar Cap Boundary

Closed: Magnetic field (MF) lines with both ends connected to the ionosphere

Open: MF lines with one end connected to the ionosphere and another end to the interplanetary space